RESEARCH WATCH JANUARY 2012

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BEEF CATTLE

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Beef cattle

Transport effects and shrink

Geni Wren, Bovine Veterinarian Magazine | Updated: October 25, 2011

Cattle can get transported three to seven times in their lives, and there is increasing public concern about the transport conditions of livestock.

Karen Schwartzkopf-Genswein, PhD, Agriculture and Agri-Food Canada, told attendees at last week's American Meat Institute conference in Kansas City, Mo., that there has been relatively few studies looking at the effects of transport on cattle in North America. She noted that there are several European transport studies, but the systems are not comparable to North American livestock transportation systems.

Schwartzkopf-Genswein and others surveyed the time-on-truck for 6,000 long-haul cattle trucks. The range was 4 to 56.7 hours, with an average time-on-truck of 16 hours. Fat cattle were on the truck an average of 16 hours, while feeders were longer at 22.4 hours because they were off-loaded at the border for inspection.

Out of 6,000 loads, the average shrink was 5.3%, with fat cattle having 4.9% shrink and feeder cattle having 7.7%. For every hour there was .15 kg of shrink. Cattle hauled the longest – 56.7 hours – had an 8.5% shrink. Schwartzkopf-Genswein explained that at 30 hours in transport, animals can't lose any more water weight and shrink will then come from tissues. Also, feeders, calves and cull cows were more affected by shrink than were fat cattle.

Another study of ventilation perforation patterns of truck (Duffy pattern vs. punch-hole pattern) showed that the nose and belly were the hottest compartments in the Duffy, and the nose was the hottest compartment in the punch-hole patterned trucks.

The study showed that from a temperature-humidity-index (THI) from 60 to a THI of 80, the economic loss from shrink was $38.13 and $66.42, respectively.

Schwartzkopf-Genswein summarized the research and research needs:

Fat cattle had the fewest issues in transport
The industry needs to rethink transport times
Trailer type, design and ventilation need to be looked at further
The industry needs scientific assessments on ventilation, density, etc.

Making the most of weaning

Beef cattle

Iowa Beef Center | Updated: October 14, 2011
Source: Dan Loy, Iowa Beef Center

Management of the calf after weaning

The first 30-45 days after a calf is weaned is perhaps the most stressful period of its life. Good performance and health during this time can set the stage for an efficient and profitable feedout, or a long and productive life in the cow herd.

On the other hand, most of the sickness and death loss due to respiratory disease happens at this time. Respiratory disease affects one in seven feedlot placements and is the leading cause of death loss. Recovered cattle also gain more slowly and may have lower value carcasses than healthy cattle. Also, digestive upsets that occur here may have side effects later.

Feed selection

Many times calves are introduced to new feeds for the first time at weaning. Not only is mothers'milk and grass the primary feeds that the calves are accustomed to; the rumen bacteria are adapted to them as well. It takes 1-2 weeks for the rumen microbial population to adapt to new feedstuffs and the introduction of grain requires a major shift.

Start out with feeds that the calves are accustomed to. If the calves have been creep fed, the feeds used in the creep should be part of their grain mix at least for the first few days. Don't drag the creep feeder into the weaning pen though. Newly weaned calves may increase their voluntary consumption dramatically which could cause digestive upsets.

It is better to manage the feed consumption of the calves. Calves are adapted to grass; so long stem hay for the first 3-7 days is a normal recommendation. Calves often prefer a dry grain mix at first, but will quickly adapt to high moisture feeds, including corn silage and wet corn co-products over a 1-2 week period.

Management checklist

Feed bunk space—18 to 24 inches, enough space so all the calves can eat at one time

Lot size—200 square feet per head or less. Calves will walk the fences in large pens which can be stressful.

Shelter—dry and well ventilated and at least 20 square feet per head

Water—accessible by sight and sound if the calve are not accustomed to the watering system

Beef cattle

Trailer compartments and density

Bovine Veterinarian Magazine | Updated: October 11, 2011
Brad White, DVM, MS

Does the section of the trailer that the calf is in make a difference in risk of illness or performance? That's a hard one to quantify, but some researchers have been looking at the different compartments of livestock trucks where cattle stand, including vibration level, wind, temperature and other factors.

Studies done by Brad White, DVM, MS, Kansas State University, evaluated the potential impact of being housed in intone of the eight different truck compartments in a standard transport trailer. When unloaded at the feedyard, those calves were identified by trailer compartment and monitored through a backgrounding phase. "We saw a difference in average daily gain up to the point of re-vaccination based on which compartment of the truck they were in, and cattle in the rear had a little bit lower average daily gain," says White. "They were gaining about 3.5 pounds a day to that point. There was a higher average daily gain in the front two compartments."

Looking at just the rear, middle and nose section, the same trend holds true, White says. "If we compare the nose or front of the truck to the back of the truck we see a difference in average daily gain." However, White notes, it's important to point out that this difference was transient. "We saw it by day 14 but did not see any difference when we got to backgrounding closeout at day 50."

Some observations White's research revealed are that cattle in the forward section of the trailer were less likely to be treated than cattle in the middle. "The interior of the trailer is not homogeneous; we need more research here to determine why," he says.

Also, calves in compartments with less than 15 head tended to have less morbidity compared to those with more than 16 head. White makes it clear he's not advocating shipping cattle in small lots and small trailers, but when possible, keeping them in relatively small groups within the truck by shutting gates and separating compartments may decrease morbidity.

Cattle transportation studies
White and David Renter, DVM, PhD, Kansas State University, have worked with a team of researchers and collaborating veterinarians and feedlots to collect operational data from feedlot production systems. This work was funded through a USDA grant and the objective is to use these data to generate information that will improve decisions related to preventive and therapeutic management of disease in feeder calves.

“As a part of this grant, the team has worked to identify factors influencing the disease risk in feeder calves in order to improve our ability to more accurately predict health outcomes after arrival,” White explains. “Variables describing shrink and the distance cattle traveled to the feedlot were evaluated to determine potential associations with BRD after arrival.”

Help new cattle adapt to the feedlot

Geni Wren, Bovine Veterinarian Magazine | Updated: November 8, 2011

The slower, easy approach to newly arrived cattle, when applied properly, is readily evident in the comfort level of the pen.
There are a variety of reasons incoming feedlot cattle can get off to a slow start, including cattle with health issues, “country cattle” that are unaccustomed to feedyard traffic and new rations, inclement weather, long hauls and social interruption of the pen.

Carter King, DVM, Cactus Feeders, Amarillo, Texas, says it’s important to evaluate incoming cattle that might have some of these problems so you can assist your clients in getting them off to a good start. “For example, cattle from the big pastures of West Texas generally stay at the back of the pen,” King explains. “They don’t have any health problems and are in good condition, but are simply afraid of all the commotion.”

These cattle take a little bit more care, he says. “If you look at the intake graphs over time and you look at closeout intakes, you may not be able to tell any difference in these cattle. But these definitely have to be managed somewhat differently than the other pens.”

Four “rocks”
Cactus Feeders is the world’s largest privately owned cattle feeder with 10 cattle feedyards in Kansas and Texas with a total capacity of 520,000 head at one time. Because of the wide variety of cattle that arrive at Cactus, King uses a “rocks” system to break down certain problems or issues with different pens of cattle. These are:

* Adaptation
* Feed
* Internal parasites
* Health

“These four major areas give us the parameters to evaluate how well the cattle are going to acclimate to their new environment,” he explains. “All of them generally will have some impact, especially on commingled cattle. Within each group that you want to specify or look at, any one of these might

apply. Sometimes it's two or three of them."

King says some groups of cattle will have higher internal parasite loads than others, some will have more health (such as BRD) problems than others, some will be more timid and apprehensive around traffic, people and horses than others and some will simply not like
the new feed especially in a feed bunk rather than on the ground. "Identifying these allows us to focus more on which 'rock' we need to approach in the arrival phase."

This system, however, takes a team approach. "We have to ensure that there is good communication among cowboys, feed callers, tank washers, etc. on how to interact with these cattle so everyone is functioning as a team," King adds.

It starts off the truck
The first impression new cattle get of a feedlot starts the moment they get off the truck and how they are handled. This is where King's "adaptation" rock fits in (see sidebar).

"That animal's first experience at being handled after he has been unloaded and put in the pen is critical to us," King says. "One of the things that has helped us accomplish that is the Bud Box and the Daniels alley. I think these have done more to revolutionize how we do business than many other things."

Many cattle arrive with only a history of "they were loaded at 'city, state' and sent to our feedyards," King says. "In the majority of cases we have no information on previous health programs or diet as well as how much they have been handled. Our initial observations of the cattle should guide us on how much is going to be required to adapt the cattle to the yard." King says when his team addresses the problem areas during the arrival phase, their results are much better than when they try to catch up at a later date.

When cattle are acclimated in a very low stress environment by people who understand why an operation is doing these things, King sees much more success. "The slower, easy approach to newly arrived
cattle, when applied properly, is readily evident in the comfort level of the pen," he says. "Cattle are moved back and forth to hospitals easier, lameness issues are reduced and generally early intakes improve."

Certain facilities are more conducive to lower stress movement through processing barns than others. "However, when people do not understand the philosophy of what we are doing, why we are doing it and how to do it, no facility can overcome this," King says. "Veterinarians play a crucial role in the initial training, evaluation and repeated hands-on monitoring of proper

handling techniques."

For example, King provides where they had a newly arrived alley of feeding pens where the cattle were all crowded at the back because of one guy in a welding truck. "We have to be cognizant of what we are doing with these animals," he says. "Pipes break and we have to fix them. Water troughs leak and we have to fix them. Strays get out and we have to get them. But we have to understand that there are ways of doing it and way of adapting cattle so these things don't become issues."

Other "rocks"
As far as the "parasite" rock, King believes if a substantial load of internal parasites is removed at some point prior to entry into the feedyard, "we should effect an improvement in performance. However, we don't know which animals have substantial loads and which do not. Since we can't visually determine parasite loads of incoming cattle, we deworm every animal that enters the feedyard, because we know that a good portion of them should benefit from the deworming, we just don't know which ones they are."

Carter says health programs can be difficult to get your arms around because there can be many different programs as well as other people making decisions about them. "We have 10 feedyards and nine different health programs," he says. "Our general managers have the final say on what drugs we use. We do make recommendations, which sometimes creates lively discussions. We have to manage the hospitals. We have to manage the way the cattle are handled. We have to manage how the cattle were adapted when we received them. That's where we make our money. As long as they are administered a premium antibiotic whenever they get pulled, I think we write their history long before that point."

Priorities
Carter believes in identifying priorities for incoming cattle that will help them have a successful growing phase at the feedlot. They are:

* Low-stress handling of cattle
* Facilities (i.e. Bud boxes and Daniels alleys)
* Feed and bunk management
* Health programs
* Minimal movement (i.e. fewer trips for re-implanting, etc.)
* Continuous training of employees

"The variability of the cattle we get is tremendous," Carter notes. "What we try to focus on is adaptation because our health programs are pretty well set. We know what we are going to administer and when we are going to do it and how long we are going to leave those cattle alone after we administer those medications. Handling the cattle correctly while we are putting them

through processing barns, cleaning out and managing the hospitals are the areas where our focus has to be."

Six ways to help cattle adapt
Acclimating new cattle the feedlot takes good management and animal husbandry skills. Carter King, DVM, offers these suggestions for helping new cattle get off to a good start:

1. Train your employees on what low stress handling is, how to implement, and the importance of it
2. Evaluate cattle for attitude/disposition characteristics in addition to health
3. Handle cattle slow and easy through receiving and processing
4. Work with cattle on foot for the first few days to gain trust, if possible
5. Pen timid cattle in low traffic areas if possible
6. Communicate with other departments (i.e. feed delivery, maintenance) on requirements of cattle

Adaptation — what to look for
In Webster's Dictionary, adaptation is defined as: "… the evolutionary process whereby a population becomes better suited to its habitat." Carter King, DVM, believes adapting new cattle to the feedlot environment as soon as you can is critical to good performance during the feeding period. But adaptation involves more than the cattle, it also involves the people working with them.

At Cactus Feeders, Amarillo, Texas, King says adaptation includes focusing on these areas:

Type of cattle Holsteins vs. crossbreds vs. Mexican calves vs. ranch calves — you have to know what type of cattle you are dealing with.

Social structure in the pen "Social structure is critical to how that pen performs," King says. "It's what we do that screws up that social structure."

Gawkers and traffic Feed trucks, loaders, tank washers, feed callers, doctors, processors and every kind of vehicle and piece of equipment running in and out of the pens, in front of cattle, behind them, etc. "Some handle it fine," King says. "Another set runs to the back of the pen every time a vehicle goes by. Those animals take a little bit different approach."

Philosophy/experience of feed callers King says to determine how they are trained. Do they transition cattle much faster than a lot of feedlots? Do they feed a lot of hay? Do they push calves from the start? Do they have different feed calling models for a 500-lb. sale barn calf and 700-lb. yearlings? Or is it one-size-fits-all?

Pen riders King says labor is one of his biggest issues, and he continually gets a younger pen riding cowboy, processor, doctor and labor force. How do they manage their pens? Do they take pride in their home pens? How much animal husbandry do they exhibit with calves? It’s our responsibility to do the training on these individuals.

Clarkson professor takes unusual approach in cow study

FARM IMPLICATIONS: Bovines need space, Clarkson prof says
By MATTHEW BULTMAN
JOHNSON NEWSPAPERS
MONDAY, DECEMBER 26, 2011

POTSDAM — Like birds of a feather, cows tend to flock together.

That is what Clarkson University professor Erik M. Bollt and a team of British researchers found after two years of researching the bovines.

Inspired by European animal-rights initiatives and a good challenge, the team found cows like to eat, stand and sleep together.

Though it was conducted in Europe, the study has implications in the north country, too, Mr. Bollt said. It could help develop policies and teach farmers how to get the most out of their herd.

“We found they should be fed all together and you need to give them a lot of space to lie down,” he said. “This is counter to some current farming practice where they squeeze animals in a confined space to save money and room.”

The study, titled “A Mathematical Model for the Dynamics and Synchronization of Cows,” used complex mathematical models to study the animals’ behavior.

The group monitored a herd of cattle, observing the animal’s feeding and sleeping habits. What they found — don’t skimp on the cows’ comforts by squeezing them into small barns.

“You might save money on infrastructure, but the cows might be less happy and produce less milk,” Mr. Bollt said.

The article made history when it was published in the research journal Physica D: Nonlinear Phenomena, becoming the only article published specifically about cows, Mr. Bollt said.

Admittedly, the study was a little out of the comfort zone of the math professor, who typically investigates the design of airplane wings or topography problems.

“I’m not really a cow guy,” he said.

But after meeting a pair of scientists during a visit to Oxford in 2009, Mr. Bollt said, he began to consider applying his principles of math in a more

unconventional way.

“We realized they had a problem and we had a tool to fix it,” he said.

And the combination of math and science is catching on in academics, he said. More mathematics professors are teaming up with scientists to find answers to everything from how diseases spread to how to cure cancer.

And while Mr. Bollt said he has given cow math a rest for now, he said he hasn’t closed the door on science just yet.

“I am more willing than most to step outside the topical area of mathematics,” he said. “It really floats my boat to work with scientists.”

Immune Response To Stress

TheCattleSite News Desk
Thursday, December 29, 2011

US - Weaning causes stress in calves, which can lead to immune weaknesses. A recent study shows that this level of immune stress varies between gender.

Background

The molecular mechanisms by which stress induces the development of pathologies remains unclear, although it is recognised that one of the major factors affecting health as a consequence of stress is the involvement of the neuroendocrine system. In cattle, a number of necessary husbandry practices have been shown to activate the stress response, yet very little is known about the impact these have at the molecular level.

The objectives of the study were to characterise, in male and female beef calves, the immune response to weaning stress in bovine leukocytes at the physiological and molecular levels and to assess the difference between calves weaned in the presence of the dam and those weaned and penned away from the dam.

Results

Following exposure to weaning stress, total neutrophil number and neutrophil:lymphocyte (N:L) ratio increased ($P < 0.01$) in calves. Additionally, expression of pro-inflammatory cytokine genes, including IL-1β, IL-8, IFN-γ and TNFα, were up-regulated ($P < 0.01$). Furthermore, there was increased ($P < 0.001$) expression of the glucocorticoid receptor, GRα, the pro-apoptotic gene, Fas and the Gram-negative pattern recognition receptor, TLR4.

Calves penned away from the dam post-weaning had increased ($P < 0.01$)

neutrophil number and N:L ratio compared with calves penned next to the dam, and female calves had higher ($P < 0.05$) expression levels of IL-2, IL-8, IFN-γ and TNFα than male calves.

Conclusions

Weaning elicits an immediate and somewhat short-lived acute stress response in the calf. The effects serve to enhance, rather than suppress, the immune response by means of a heightened inflammatory response and cellular mobilization.

The earlier and more profound increase in neutrophil number and N:L ratio together with reduced lymphocyte number in calves penned away compared with calves penned near their dams post-weaning suggests that the former may be more sensitive to weaning stress.

The data also show a clear effect of gender in differential gene expression in response to stress with IFN-γ having increased expression in female calves compared with male calves over the course of the study.

Additionally, this study has helped to characterise the inflammatory response to stress in calves and identify a number of novel candidate biomarkers suitable for investigation in future studies of stress.

Refusal to Suckle after Colostrum Feeding

Ceptor Animal Health News, OCTOBER, 2011
Neil Anderson, Veterinary Science and Policy Unit, OMAFRA

Refusal to suckle the first meal after colostrum feeding may be common on some dairy farms. Observational data for 244 calves from one farm showed that 47% did not suckle their first meal of milk replacer after having received their colostrum. About half of the non-drinkers did not drink at the next meal. Within the non-drinkers, some were fed by nipple bottles and some by esophageal feeders, and volumes varied, with a target of three to four L. Analyses showed that refusals were similar for calves fed ≤3L vs. >3L of colostrum. However, calves fed colostrum by esophageal feeder were less likely to suckle their first meal of milk replacer. Overall, refusals at the next meal by calves fed by esophageal feeder were 57% for calves fed ≤3L colostrum and 64% for calves fed >3L (Figure 1).

The association of esophageal feeding and failure to suckle at the next meal does not imply causation; it merely gives us a hint to look deeper into the matter. For example, is the outcome associated with the act of intubation, volume of colostrum, speed of administration, or physiological changes in the forestomachs

or systemically? These data do not provide an answer.

Amongst the 244 study calves mentioned in the 'refusal-to-suckle' case study described above, there were nine deaths - four following complications of umbilical infections and five with abomasitis and/or rumenitis as part of the necropsy findings. Because of the findings of abomasitis, milk refusals, and slow starts, the owners chose to shift colostrum feeding closer to Nature's way - suckling and smaller volumes per meal. The owners will monitor their change in management by submitting dead calves to the Animal Health Laboratory at University of Guelph.

Accelerated Colostrum Feeding to Dairy Calves

Ceptor Animal Health News, OCTOBER, 2011.
Neil Anderson, Veterinary Science and Policy Unit, OMAFRA

Abomasal bloat and emphysematous abomasitis may occur rarely, sporadically, or in clusters of dairy calves on a farm. There have been calls for research that would consistently reproduce the disease and for prevention and control strategies.
(1) Signs similar to those seen in naturally occurring disease have been induced experimentally using infusions of Clostridium
perfringens
(2) or a readily fermentable substrate
(3).Nonetheless, there has been scant, if any, research in recent years. Practitioners and diagnostic laboratories continue to see cases. This article explores the role of accelerated colostrum feeding as a predisposing cause.

Accelerated Colostrum Feeding
The common advice is to feed newborn calves four litres (L) of colostrum as soon as possible after birth to provide 150-200 g of IgG that is needed to diminish the chance of failure of passive transfer (FPT). (4,5) Since average colostrum contains about 50 g of IgG/L, simple math was used to arrive at the four L. As a result, producers are force-feeding four L of colostrum in one meal - a practice based on science, assumptions, mathematical extrapolation, convenience, misinterpretation or expert advice.

The defining characteristic of accelerated colostrum feeding may be a single feeding of four L by esophageal feeder within four hours of birth. Salient features include the volume delivered, speed of ingestion, labour devoted to the task, or quantity of nutrients in the feeding.

Questioning Four Litres in One Meal
Accelerated colostrum feeding may have become rooted so deeply in calf management that what may be traumatic to the calf has become normal to us. Certainly, immunoglobulins benefit a calf. But does the volume of colostrum or

method of delivery (6) do harm? Producers who follow the advice complain about calves not suckling at their next meal. This makes calf-feeding frustrating and time consuming for producers and, perhaps, stressful for calves. Some abandon the technique, whereas others carry on while questioning the practice. During the first three days of life and with suckling their dams, daily colostrum intake for Holstein calves may vary from nine to twenty-one percent of their birth weight (7) and they consume their colostrum in several meals. With suckling, each meal is comparatively small, and since abomasal capacity is less than two L, should we force feed more than two L in a meal? Why do advisors recommend gorge-feeding colostrum yet tell producers that over-feeding is a hazard for milkfed calves? It's difficult to find information about pain, discomfort, reflux or aspiration, or a long intermeal interval following force-feeding with four L of colostrum. Yet, information in post-mortem reports for neonatal calves should make us wary about overfeeding colostrum, especially by esophageal feeder.

Ruminal Acidosis and Anaerobic Conditions
Esophageal feeders facilitate prompt and rapid administration of fluids to calves. Physical damage to the pharynx or esophagus, aspiration into the lungs, ruminal acidosis, or establishment of anaerobic conditions in the forestomachs may be unwanted side effects. Abnormal fermentation of milk in the forestomachs produces an accumulation of acid that leads to ruminal and systemic acidosis. Significant volumes of milk entering the forestomachs may change conditions from aerobic to anaerobic. Whereas suckling stimulates closure of the groove under natural conditions, use of esophageal feeders, feeding large volumes at a calf's first meal, or bucket feeding can lead to failure of the reflex, failure of groove closure and milk entering the rumen. Distension of the abomasum with large volumes of milk at one time can allow milk to overflow or reflux into the rumen. Similarly, the pressure from overfilling can force the groove to open partially and allow milk to leak into the rumen.

Ruminal acidosis in itself may cause diarrhea. (8,9) In calves fed by nipple-bottle, fluids pass directly into the abomasum. In neonatal calves fed by esophageal feeder, fluids initially enter the reticulum, then the cranial sac and the remainder of the rumen. As the rumen fills, fluids spill into the omasum and the abomasum. A volume of 400 mL may be administered into the esophagus before overflow begins from the rumen. (10)

Dehorning study results

Journal of Dairy Science | Updated: December 13, 2011

A large European study revealed producers' opinions of the widely implemented dairy management practice of dehorning. The results of 639 questionnaires completed by northeastern Italian dairy producers indicated:

More than 80 percent of farms practiced dehorning.

Disbudding was the most common method of dehorning, at an average age of 32 days.
Hot-iron cauterization was preferred by 91 percent of respondents as their chosen method of disbudding.
Dehorning typically was done by farm personnel, but farms with 30 cows or less were most likely to use the services of a veterinarian to perform the procedure.
Most farmers (70 percent) stated that they had not received any specific training on how to perform disbudding.
While more than half (52 percent) of respondents reported that disbudding causes prolonged postoperative pain, only 10 percent of producers used local anesthesia before cauterization, and just 5% provided calves with postoperative analgesia.
Limited willingness to incur additional costs was the most frequently cited reason for not using pain-management methods.
About half (54 percent) of producers who favored keeping horned cattle noted aesthetics as their key motivation. Some stated that horned cattle were more attractive to consumers when milk and dairy products were sold directly at the farm.
Of the producers who kept horns intact, 74 percent reported no difficulty in handling horned cattle.

Short dry period: Some pros and cons

By a Dairy Herd news source | Updated: December 28, 2011

The University of Laval in Canada recently compared the effects of two different dry period lengths on health and reproduction. The study, published in the July Journal of Dairy Science, featured 850 Holstein cows from 13 commercial dairy herds that were assigned to either a 35-day (short) or a 60-day (conventional) dry period, based on milk yield, number of calves and estimated calving interval.

Cows enrolled in the conventional dry period group were fed a dry cow ration from dry-off until 21 days pre-partum, at which time they were switched to a precalving ration. A pre-calving ration was fed to cows of the short dry period group throughout the entire shortened dry period.

Results showed:
• Dry period management did not affect culling rate for second-lactation cows, but a significantly higher culling rate occurred in multiparous cows with conventional dry periods compared to those with short dry periods.
• Lower incidence of metabolic disorders for second lactation, compared to third or later lactation cows in both groups.
• Cases of mild ketosis were lower for cows in the shortened dry period group.
• Occurrence of retained placenta was higher for second and later lactation cows in the short dry period. However, this did not lead to increased cases of metritis.

Researchers concluded that a short dry period can transition cows back to the milking herd sooner without major effects on health and reproduction parameters.

Group housing insights

Land O'Lakes Purina Feed | Updated: December 23, 2011
*Reprinted with permission from Marina von Keyserlingk and Dan Weary, UBC

Raising calves is arguably one of the most challenging and labor intensive jobs on the farm. However, recent studies indicate that group housing may be an option to reduce labor associated with raising calves. Research is also showing that there are additional benefits to the calf such as increased milk consumption, socialization and exercise.

Marina von Keyserlingk and Dan Weary, animal welfare experts with the University of British Columbia, shared key points that you should discuss when considering group housing. The following points were presented at the Cornell Nutrition Conference this fall:*

- Think through group size. Successful group rearing requires appropriate management, which includes selecting the appropriate group size. Smaller groups are easier to manage; we recommend group sizes of less than 10 calves.
- Decide what feeding method you will adapt. Successful group housing requires nipple feeding. Feeding more milk reduces competition and improves efficiency of use of automated feeders.
- Take into account design and management of the housing system. Cleanliness and ventilation will affect disease susceptibility more than group housing.

All-in, all-out management of groups aims to reduce the risk of disease.

Effective group housing requires excellent management; do not attempt housing calves in groups if you are currently struggling with high rates of calf mortality and morbidity or if your farm struggles with ongoing problems with colostrum feeding.

Pre-fresh, maternity & post-fresh space: Getting the numbers right

Dan F. McFarland, Penn State | Updated: October 19, 2011

The importance of proper care and management of dairy cows during the final 60 to 45 days of their pregnancy cannot be overstated. The nutrition, health care and environment provided during this period have a tremendous influence on their health and performance well into the next lactation.

To keep stress at a minimum the dairy shelter "basics" which include providing excellent ventilation, a dry comfortable resting area, good access to feed and water, and a confident footing are the same for all dairy animals. Some minor adjustments to the feeding space and resting area stall and/or pack space are necessary to accommodate the cow's slightly larger size, reduce stress, and improve cleanliness – especially for those cows close-to, during, and after calving. Avoiding group overcrowding – especially in the close-up and maternity areas – is extremely important in keeping stress to a minimum.

Reproductive performance peaks and valleys caused by such factors as heat stress, environmental stress, and new animals entering the herd create fluctuations in dry cow population. These fluctuations present a design and management challenge trying to match the space available to the number cows occupying it. Increasing building size increases initial cost, however overcrowding the shelter increases stress which can cause health complications such as retained placentas (RP) and left displaced abomasums (LDA) that can significantly affect herd performance and profitability.

Typical grouping for cows from 'dry-off' to 'post-fresh' include:

'Far-off' - dry-off until ~3 weeks pre-freshening
Freestalls: 4" wider than those used for lactating cows (52" typical)
Bedded pack: 80 – 100 ft2 bedded area per cow
Provide 27" – 30" of feeding space per cow
Provide restraint facilities for vaccines & observation (headlocks or chute)

'Close-up' – cows ~3 weeks (heifers 4 wks) pre-fresh to a few days (hours) pre-calving
Freestalls: 4" wider than those used for lactating cows (52" typical)
Bedded pack: 100 – 120 ft2 bedded area per cow
Provide 27" – 30" of feeding space per cow
Provide restraint facilities (headlocks or chute)

'Maternity'- few days (or hours) before to few hours after calving
Box stalls: 16' x 16' (12' x 12' minimum)
Area for fresh feed & water if kept more than 1-2 hours
Restraint facilities for calving assistance
Freshening pack: 150 – 200 ft2 bedded area per cow
Provide 27" – 30" of feeding space per cow
Restraint facilities for calving assistance

'Post-Fresh' -1 – 3 days post-calving
Shelter recommendations similar to 'far-off' group
Many designers assume 'uniform' calving year-round, 12 month calving interval, first calving at 24 months and a 30% culling rate. In practice these guidelines fail

almost immediately since ‘uniform calving’ is difficult to achieve – especially in expanding herds where large numbers of cows are purchased to fill the stalls available. In an attempt to develop some ‘real world’ guidelines, Dr. Bill Stone, studied the number of freshenings of 160 NY dairy herds over a 365 day period. Approximately 26% of the herds freshened at least 5% more than the total number of cows. The study also examined the monthly distribution of calving to see if herds exceeded the uniform calving rate by 25, 35 and 50%. Only 10% of the herds surveyed had no months when the pre-fresh and maternity areas were not overcrowded. Where pre-fresh and maternity areas were sized according to a uniform calving model, 65% of the herds were 25% overcrowded for at least 2 months of the year, while 40% were overcrowded 35% for at least 2 months. For at least one month, over 40% were overcrowded by 50%. Therefore, it seems that facilities for pre-fresh and maternity cows should be sized perhaps 30% larger than the uniform model to reduce overcrowding of these areas. Table 1 illustrates the difference between the ‘uniform model’ and ‘real world’ study for a total herd size of 100 cows.

Of course, increasing facility size increases initial investment as well. While the exact cost of overcrowding pre-fresh and maternity areas is difficult to determine. Overcrowding can lead to increased stress that may increase the incidence of freshening health disorders such as retained placentas (RP) and left displaced abomasums (LDA). Some estimates indicate that each RP and LDA cost a dairy over $200 and $300, respectively. Relatively minimal decreases in each of these disorders can justify the additional costs to provide more space and reduce stress (Stone, 2000).

Keeping stress at a minimum throughout the dry and freshening cycle increases the chance of cows calving without health problems and entering the lactation cycle productive and in good condition. Meeting the environmental and space needs of these special cows is a key element in a successful overall pre-fresh, maternity, and post-fresh management program. Do the numbers add up for your pre-fresh, maternity, and post-fresh needs?

Reference: Stone, B.. 2000. Defining and Managing Special Cows. Dairy Housing and Equipment Systems (NRAES-129). Natural Resources, Agriculture and Engineering Service, Ithaca, NY. pp 333 – 339. ----- Dan F. McFarland, Sr. Extension Educator—Agricultural Engineering, Penn State Extension

Housing plays a critical role in calf welfare

By a Dairy Herd news source | Updated: October 18, 2011
Source: Dairy Calf & Heifer Association

Housing is one of the standards covered in DCHA's new Gold Standards III, which focus on animal welfare for dairy calves and heifers. Pennsylvania State University researchers, in their "Calf Housing as Medicine?" article, maintain that

housing is not only important for calf performance, but for animal welfare as well.

Because calves are born with immature immune systems, they are particularly vulnerable to environmental stressors such as poor air quality, drafts, filth and extreme heat and cold. The following Penn State recommendations for optimal housing environments also compliment DCHA's Gold Standards housing guidelines:

Air quality - Moisture, gases, pollutants and airborne pathogen load should be minimized, so that air quality is similar to fresh air outside.

Ventilation - Air movement requirements vary by season. Minimizing drafts in the winter is critical because young calves lack the ability to efficiently generate their own body heat. Higher air exchange rates are needed in the summer to promote good air quality. Pen design and management should provide flexibility in regulating air movement based on environmental changes.

Calf pen design - Fixed solid side walls and rear panels generally are not recommended because they limit air exchange at the calf level and promote moisture accumulation. Pen design should allow calves to choose the most comfortable space. Providing at least 8 feet of pen length will allow calves to eat at one end and defecate at the other, while still providing dry resting space.

Bedding - Deep bedding (6-10 inches) promotes a dry, erect hair coat, which provides extra insulation. Maintaining clean, dry bedding will prevent consumption of "manure meals" via fecal-oral contact. At least three inches of dry bedding should be placed over soiled bedding. Removal of soiled bedding should be based on environmental conditions versus the calendar.

In the end, both welfare and health benefit. The Penn State experts maintain that by reducing environmental stress and creating a space that minimizes pathogen exposure from airborne, fecal-oral and calf-to-calf contact, calves also have a better opportunity to stay healthy and continue to grow.

Check out Penn State's website for housing plans for all ages - from baby calf shelters, hutches and pens all the way to drive-through freestall heifer housing - for more ideas on improving the housing in your operation.

Welfare and modern veal production

Geni Wren, Bovine Veterinarian Magazine | Updated: November 1, 2011

Speaking at the 2011, American Meat Institute Animal Care & Handling Conference in Kansas City, the American Veal Association’s Drew Vermeire,

PhD, PAS, Dipl. ACAN, said many consumers don't know the difference between a dairy calf and a veal calf. On one hand, a veal calf is a dairy calf, but a dairy calf is not always a veal calf.

"A veal calf is not what most people think," Vermeire said. He explained that the modern veal industry involves 400,000 baby dairy bull calves and 535 million pounds of whey solids, from 9.5 billion pounds of milk. "Whey solids used to be thrown out from cheese processing," he explained. "Calves can digest whey and it is an excellent source of nutrition."

Vermeire further explained that the veal industry is the number one single source customer for whey solids. "We use 300 million pounds of milk replacer for the veal industry, all in 50-lb bags. Calves are fed with the best care. They are housed in climate-controlled housing with a lot of individual attention and care."

Vermeire says in modern systems dividers are placed between calves because the first few weeks they are susceptible to disease, but the industry is moving then to group housing. "Veal calves get hands-on individual care," he stressed. "They have exceptional management supervision and nutritionists and consultants on the farm every week.

Vermeire says the Veal Quality Assurance program includes:

A Valid Veterinarian-Client-Patient-Relationship (VCPR)
Is a model program for other species
Encompasses farmers and industry
On-going education and re-certification
Fits into packer HACCP programs
Good management practices
Biosecurity

Veal production isn't without its challenges, however. Vermeire says economics play a big role in production. Feed ingredients are at near record high prices, and carcass prices are below production costs. There are big swings in whey and it can cost $2,000/ton for feed." He said the industry will continue to use more plant-based ingredients such as wheat protein, soy protein, extruded flour, etc. in milk replacers. "We will continue to improve production methods to lower the cost of production, and we'll likely see more consolidation to improve industry-wide efficiency."

The American Veal Association has a resolution to address consumer preferences and will move to transition all veal operations to group housing on an industry-wide basis by 2017. "It's a work in progress," Vermeire said. "Different skill sets are needed. Not all calves like to be in groups. There can be bullying behavior from young bulls as they get bigger – they are 500-lb calves when they go to slaughter. In pens there can be biting tails, sucking on each other, riding

and lameness issues."

It's also expensive to make the transition because there is more variation in group-penned calves. "Decisions need to be science-based rather than emotion-based," Vermeire said. "The veal industry will meet the challenge that consumers want of tether-free veal. We are ahead of schedule with the transition to group housing."

"Bob" veal is not "real veal"
There have been some reports about veal calves being tested positive for antibiotic residue, but Vermeire wants to clarify that that tends to be the case of a "bob" dairy calves sold to slaughter, and not a calf from a veal operation. "They are veal in name only," he explained. "When a dairyman takes a bob calf to the sale barn with a residue, the veal industry gets a black eye. Bob calves should be classified as dairy calves, not veal."

Vermeire went on to explain that veal has an excellent safety record with a lot of veterinary oversight, and veal has a very low rate of positive residues even with a disproportionately large amount of testing compared to other types of meat.

Calving pens: individual vs. group
By a Dairy Herd news source | Updated: November 2, 2011
Source: Michigan State University

Editor's note: The following article was written by Phil Durst, Michigan State University extension dairy educator

The calving pen is one of the most strategic locations on the farm. The principals of good calving pen management include:

Comfortable and low stress for the dam.
Low health risk to dam and calf.
Opportunity for seclusion by dam.
Convenience for people working with the cow and calf.
There are various ways to achieve those objectives. Access to clean, dry pasture is the oldest option that farmers have used and is still ideal during times of the year when weather is favorable. But as we've moved cows inside on many dairy operations we've tried to keep the best of pasture and add convenience to monitor calving and the ability to feed and water them.

Traditionally, we have recommended individual calving pens as the preferred maternity facility. Calving in individual pens makes it easier to work with the dam and to reduce the opportunity for both the cow and the calf to be exposed to manure-borne pathogens from other cows.

Cows may be in the calving pen anywhere from a day to a week. In cases like this, designing pen layout and managing for access to fresh feed and water is important. Another factor to consider when cows are in individual calving pens an extending period of time is the isolation of these social animals away from herdmates and the potential impact of that on fresh cow performance.

As farms get larger

A disadvantage of individual calving pens can be the number of pens and space it takes for a large herd. According to Cook in “Makin’ Me Dizzy – Pen Moves and Facility Designs to Maximize Transition Cow Health and Productivity,” a 1,000 cow dairy will average 20 calvings per week, with a range of 10 to 45. To accommodate 90 percent of calvings, the author estimates pen requirement as 140 percent of average weekly calvings. If a producer planned facilities based on this estimate and kept cows in pens for an extended period of time, this would mean dedicating more than 4,000 square feet of pen space for calving at approximately 144 square feet per pen.

Therefore, some farms use group calving pens with less than the proportional space. While recommended space for group maternity pens (Graves et al.) is 175 – 200 square feet per cow, some farms have pens sized for far fewer than the 140 percent of weekly calvings. While this reduces the building space, the basic principals of maternity pens including opportunity for seclusion by the calving dam and reduced risk of exposure to manure for both the dam and the calf still apply. Therefore, management becomes even more critical in a group calving pen and potential risks are higher.

To mitigate risk in group calving pens and to lessen the space demand of individual pens, as well as to improve calving performance, some farms are moving cattle into calving pens later in the calving process and keeping them in the pen for a shorter length of time.

Length of time in calving pen

One farm used to move cows from a freestall close-up group to individual calving pens when they noticed the birthing process was started. However, they experienced too many cows that would stop progress on birthing after the move and as a result would require intervention and frequently, pulling calves.

Maybe this was because of the activity level around those pens since the herdsman’s office was located there, but whatever the reason for the interruption of calving, something needed to change. They changed the point in time when they move dams into the maternity pen, waiting until the cow is much further along in the calving process. Now when they move them, cows are seemingly past the point of no return in calving and usually calve within an hour and without assistance.

A system like that depends on frequent observation (every 20 minutes around

the clock) of the close-up dry cow pen and knowledgeable and committed employees to move animals at the optimal time.

This type of system also deemphasizes feed availability in the calving pen because it is used for such short periods. That can be an advantage in logistics. Cows on this farm are in the calving pen generally for only 1 to 2 hours.

Another producer loads pens with animals two-three weeks prior to expected calving and then does not bring any new animals into that pen thereafter. This controls both socialization and pen density. Cows will leave the pen when they calve.

There is no one best answer for a calving pen system. It depends on space and labor constraints on each farm. However, each system requires a high level of management of this critical time for both dams and calves. Keeping the keys in mind, training employees to provide consistent and prompt care, and evaluating the results for both cows and calves will help you to achieve a high level of performance.

Intensity of Oestrus Signalling Is the Most Relevant Indicator for Animal Well-Being in High-Producing Dairy Cows

12 October 2011
SAGE-Hindawi Access to Research Veterinary Medicine International Volume 2011, Article ID 540830,
Author/Organization: Emanuel Garcia, Jan Hultgren, Pontus Faellman, Johanna Geust, Bo Algers, George Stilwell, Stefan Gunnarsson, Heriberto Rodriguez-Martinez
Publication year: 2011
http://www.fao.org/fileadmin/user_upload/animalwelfare/VMI2011-540830.pdf

Between 1997 and 2007, world milk production increased by 27% (122 million tonnes). By 2009, prevailing input costs, alongside the complex worldwide recession, led to a dramatic fall in milk prices and a subsequent decrease in the rate of expected milk production growth. Milk volumes were maintained by a gradually reduced number of high-producing cows. However, high milk production can negatively affect animal welfare, including the documented global decrease in average dairy herd reproductive performance, mainly in the dominating American Holstein breed.

Cranky Cows A Growing Problem For Oz Farmers

Friday, November 18, 2011
TheCattleSite News Desk

AUSTRALIA - ‘CRANKY COW’ syndrome is a growing problem often overlooked

by Australian dairy farmers, said a speaker at a field day in south-west Victoria.
Meriden Animal Health

Cows get temperamental, give less milk and development ailments including heat stress and staggers. It is caused by toxins produced by rye grass endophyte.

The topic arose at a More Milk, Less Stress field day on 25 October at Ecklin, near Terang. The organiser, Farmgate Stockfeeds, aims to help dairy farmers lift milk output and cope better in tough times. Farmers also heard about how to deal with stress.

Ruminant nutritionist Damian Moore, Director of Feed Safety with Meriden Animal Health, told the field day 'cranky cow' syndrome is more of a problem than most farmers realise.

"They often blame the weather, dogs and all sorts of things for cows are playing up, but the problem is caused by these toxins produced by the endophytes in their pasture," Mr Moore said. "Most farmers don't realise the cause because the toxins have been in the pastures for so long and so have the effects."

The toxins cause staggers, heat stress, lower feed intake, reduced milk production and general irritability. "Affected cows will be temperamental and tend to strike out, kick the cups off and be frightened easily," Mr Moore said.

Endophytes are particularly prevalent in perennial ryegrass and tall fescue and most frequently are found in older pastures.

Mr Moore said Australia's meat industry lost about $60 million a year in stock and production loss due to endophyte toxins.

Extreme cases in hot summers could result in multiple animal deaths, he added.

No silver bullet cure exists, though Fusion, a new microtoxin binder, work well in reducing the direct effects of perennial ryegrass toxicity.

Skinny cows: A source of sore feet

Dairy Herd Management
Kim Schoonmaker | Updated: January 3, 2012

Lameness is a huge - if not the single biggest - animal-welfare challenge facing the dairy industry. "Lameness is a really big issue," says Temple Grandin, well-known Colorado State University animal scientist and animal behavior consultant.

Most experts agree the incidence of lameness in the dairy industry lies between 25 and 30 percent, which is unacceptably high. It also is largely underestimated on farm.

“If you ask someone, ‘What percentage of your cows do you think are lame?’ two studies have shown that they underestimate it by about half,” Grandin said during a recent lameness webinar hosted by Dairy Herd Management.

Lameness also is one of the most costly diseases to the dairy industry, affecting fertility, cow survival and milk production.
Now there also is evidence linking body condition score and lameness. In fact, it suggests poor body condition is a cause, not a consequence, of lameness.
Here’s why body condition is an important risk factor for lameness that demands your attention.

An overlooked cause

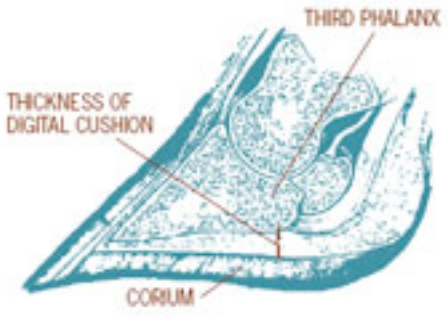
Lameness is often the result of poor facility design, cow comfort and management. Poor body condition, on the other hand, has long been thought of as an unfortunate outcome of lameness, not part of the cause. Evidence contradicting this perception was first published by Cornell University researchers in the July 2009 issue of the *Journal of Dairy Science.*
The study found an association between overall body condition and the thickness of the fatty tissue in the digital cushion of the hoof.

“So the better condition (cows) are in, the more digital cushion they will have,” explains Rodrigo Bicalho, veterinary researcher at Cornell University.

Conversely, cows with low body condition have thinner digital cushions, which sets them up for lameness problems.

“If you look at your hand, the cushion in the palm of your hand is equivalent to the cushion that cows have in their foot inside the claw,” Bicalho says. “We also have it on the bottom of our feet.”

Where lameness starts



This illustration shows the location and thickness of the digital cushion in the hoof. Thinning of the digital cushion decreases its ability to protect the corium tissue beneath it. Damage to the corium translates into lameness.
In the cow, the digital cushion lies between a bone in the claw called the third phalanx and the corium tissue beneath it. (Please see “Where lameness starts” above.)

“The function of the digital cushion is to dampen the compression that is exerted (on the corium) by the body, by the bones in the legs,” Bicalho says. “It’s part of (her) suspension system. It’s the same thing we have in cars… to help absorb impact.”
Less digital cushion translates into increased trauma to the corium, which can result in sole ulcers and white line disease, the telltale hoof lesions associated with lameness.

“Sole ulcers are a disruption or interruption of horn production by the corium,” Bicalho explains. “Then you also have the abscesses, most commonly white line disease, which is also a consequence of trauma to the corium tissue.”

Early lactation: a critical time period
Vigilance during early lactation is especially important for heading off lameness associated with poor body condition.

“As cows go through body condition loss in early lactation, the actual fat pad (digital cushion) decreases in thickness, too,” says Gerard Cramer, consulting veterinarian with Cramer Mobile Bovine Veterinary Services in Stratford, Ontario, Canada. “There’s a relationship between the thickness of that fat pad and the incidence of ulcers and white line disease.”

The Cornell study found that thinning of the digital cushion was most prominent during the 120-day window after calving. This is when body fat reserves are summoned by the cow to make milk.

Loss in thickness of the digital cushion seemed to bottom out around 120 days in milk, Bicalho says, “and after that it starts to recover.”

However, the damage has already been done to the sensitive tissues in the hoof that are at risk for injury.

Early intervention needed

Close monitoring of body condition and corrective action to fix problems needs to begin as early as the dry period.

A study published in the October 2011 issue of the *American Journal of Veterinary Research* shows that body condition during the dry period can be an indicator of lameness after calving.

“We can predict which cows will become lame in the subsequent lactation based on data collected during the dry period,” Bicalho says.

Continued vigilance of body condition is vital when lactation commences.

“The ideal body condition score at the beginning of lactation should be between 3.0 and 3.25,” Bicalho says. Intervention to alleviate lameness problems associated with low body condition scores doesn’t have to be complex. It can be something as basic as changing milking frequency.

A clinical trial published in 2011 in the *Canadian Journal of Veterinary Research* found that when milking frequency decreased from 3X to 2X, the body condition scores of lame cows increased and their rate of recovery improved — all without jeopardizing milk yields. (Please see “2X vs. 3X milking” above)

“(With 2x milking), you can speed up recovery from lameness, yet still maintain the same levels of milk production,” Bicalho says.

“We need to start measuring lameness,” says Colorado State’s Grandin. “(You) need to actually count it, otherwise you won’t manage it.”

Given its link to lameness, you now have good reason to extend that philosophy to body condition.

Hogs

Quantifying and Understanding Tail Biting in Pigs

The Pig Site I updated January 5, 2012

Complying with EU legislation on tail docking is made difficult because of the intractability of tail biting in pigs, according to Laura Boyle of Teagasc.

Tail biting is an aberrant behaviour performed by pigs and strongly linked to intensive production methods. The behaviour consists of two stages: stage 1 involves a pig manipulating another pig's tail in its mouth, often with little or no reaction from the recipient; and, stage 2 is the often frenzied cannibalism of the tail. While stage 1 is common under intensive conditions, the behaviour only progresses to stage 2 sporadically. Risk factors include tail length, stocking density, diet, ventilation, complexity of the housing environment and health status. This multifactorial aetiology makes tail biting an intractable problem, which causes pain and poor welfare for thousands of pigs and considerable distress for the people looking after them. Additionally, tail biting is often associated with infection, leading to abscesses on the spine and, ultimately, the condemnation of carcasses at slaughter, which has significant economic implications.

Tail Docking

Tail docking (removal of a portion or all of the pig's tail, usually within a few days of birth) is widespread in the EU (European Food Safety Authority, 2007) and has traditionally been used to reduce the potential for tail biting. However, docking is not a panacea and if circumstances are stressful enough (e.g. blocked feeder or drinker in an overcrowded pen), pigs may still bite docked tails or else resort to biting the flanks or ears. Thus, docking does not address the causes of tail biting, only the symptoms. As pigs are rarely anaesthetised for this procedure it is also an issue for pig welfare.

Complaints to the EU

A recent report on tail biting concluded that improvements to the pig's environment, e.g. provision of substrates such as straw, can reduce the risk of tail biting (European Food Safety Authority, 2007). Tail docking is regulated under the European Communities (Welfare of Farmed Animals) Regulations 2010, which was brought into Irish law under Statutory Instrument 311 in 2010. Thus, routine tail docking is no longer permitted, and 'other measures shall be taken to prevent tail biting and other vices taking into account environment and stocking densities'. If these measures fail and there is evidence that injuries to other pigs' tails have occurred, then non-routine docking is permissible. In July 2009, Compassion in World Farming lodged a formal complaint with the European Commission in light of Ireland's failure to ensure that routine tail docking is not carried out. However, in the case of tail biting, the welfare and ethical concerns associated with docking are arguably less of a problem for the pig than tail biting is later in life.

Factory Survey

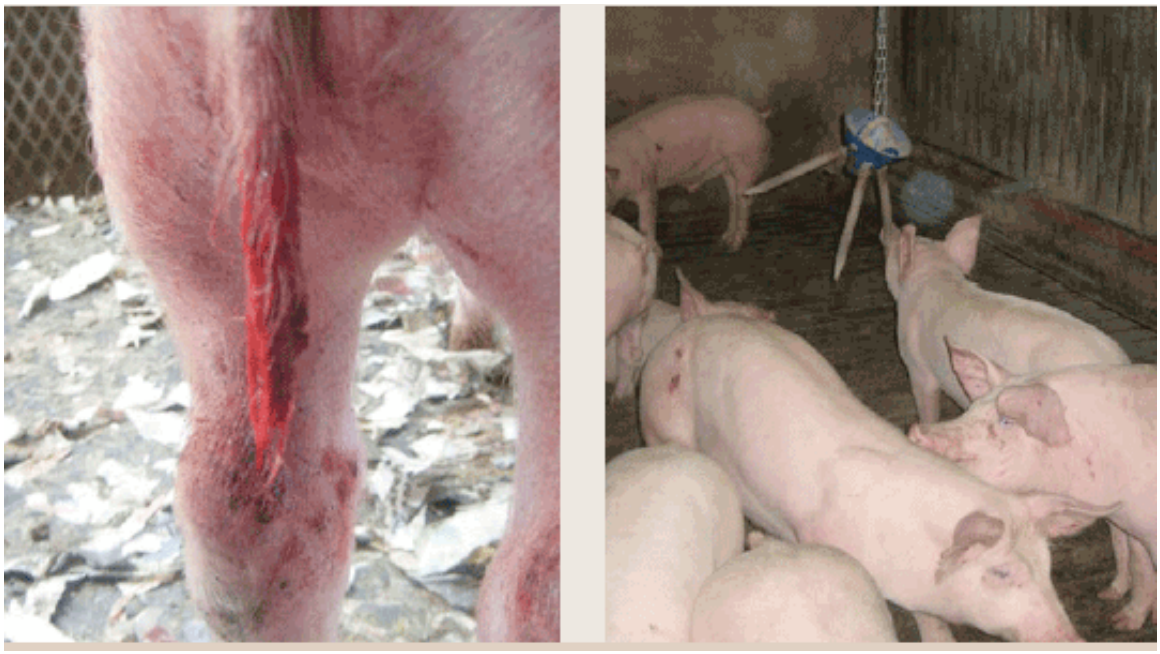
The Teagasc authors measured the actual extent of tail docking in Ireland and the prevalence of tail biting in pigs with tails of different lengths. Six abattoirs (in both Northern Ireland and the Republic of Ireland) were visited for three consecutive days each during summer 2010. The herd identification number (i.e., 'slap' number), sex, tail length (long or docked) and tail injury score of all the pigs killed in each factory on those days was recorded. The scale used to score the severity of tail biting was as follows: 0 – no evidence of tail biting; 1 – healed or mild lesions; 2 – evidence of chewing or puncture wounds, but no evidence of swelling; 3 – evidence of chewing or puncture wounds with swelling and signs of possible infection; and, 4 – partial or total loss of the tail with signs of severe infection. Inspections were conducted after the pigs came out of the scalding tank and prior to de-hairing.

High Levels of Tail-Directed Behaviour in Slaughter Pigs

Of the 36,963 pig carcasses inspected, less than half (41.2 per cent) had normal (score 0) tails. The remaining 58.6 per cent were broken down as follows: 52.5 per cent (score 1), 5.1 per cent (score 2), 0.62 per cent (score 3) and 0.43 per cent (score 4). These figures reflect an alarmingly high level of tail-directed behaviour in slaughter pigs. Admittedly, most tails received the relatively mild score of 1, which probably reflects superficial damage caused by stage 1 tail-biting. Arguably, scores of 1 could also be attributed to the washing (scalding) procedure post mortem. However, the fact that male pigs had a higher proportion of score 1, 2, 3 and 4 tails than female pigs suggests that score 1 tails were not mechanically induced. This also supports the theory that males are more susceptible to being bitten. There is no disputing the aetiology of scores of 2, 3 and 4, and the fact that six per cent of carcasses were affected by these severe injuries is of serious concern.

Does Docking Work?

Almost all pigs had docked tails (99.1 per cent). Although only 347 carcasses had undocked tails, a higher proportion of these received scores of 1 (59.9 per cent versus 52.4 per cent; $p<0.01$) and scores greater than 1 (29.9 per cent vs. 5.97 per cent; $p<0.001$) compared to docked carcasses. This indicates that tail docking prevents tail biting to some extent and lends support to producers' reluctance to abandon the practice. Producers cannot, however, afford to be complacent, and the high number of docked animals affected by tail injuries suggests that there is a lot of room for improvement in housing and husbandry practices.



left: Undocked pig with tail injury
right: Under EU legislation, pigs must be provided with manipulable materials. Ideally 'toys' should be supplemented with straw, compost or wood shavings to help prevent tail biting

Experience with Undocked Pigs at Moorepark

In a trial at Moorepark (224 undocked pigs in 16 pens), there was a persistently high level of tail-directed behaviour (around 1.2 incidences per pig per hour or 16.8 incidences per pen per hour) and there were at least 12 acute outbreaks of stage 2 tail biting over nine weeks. These resulted in 35 per cent of the pigs suffering some degree of tail amputation by the time they reached 60kg liveweight. This was in spite of excellent housing conditions, a strict intervention protocol (removal of the biting pig(s) and treatment of tail injuries) and the provision of 'toys' and chains to go some way towards meeting the environmental enrichment requirements of the pig. The experience suggests that under existing housing and husbandry conditions, tail biting could become more prevalent if tail docking is abandoned.

Casualty Pigs

The tails of pigs from the Moorepark trial were also inspected for damage at the factory after slaughter at approximately 100kg. In spite of the high level of tail biting earlier in the production cycle, none received scores higher than 2, and there were no carcass condemnations for abscessation. In contrast, 161 pigs inspected (0.43 per cent) in the factory survey received a score of 4. For injuries to become this severe, it is unlikely that the affected pigs had been isolated from the biter(s) and/or received any treatment. Such serious tail damage is entirely avoidable, as demonstrated by the Moorepark study. Even more worryingly, although scores of 4 were only detected in 0.43 per cent of pigs, they were

spread across 34 per cent of the 231 farms sampled. Pigs with such severe injuries should not knowingly be presented for slaughter as they represent a threat to food safety and in any case, they are likely to be condemned for abscesses. Furthermore, transportation of such animals is likely to cause additional suffering. These pigs should be considered as casualty animals and euthanised on farm.

Future Research

Given that routine tail docking is now prohibited by law, more effort needs to be made to prevent the causes of tail biting. Although challenging under current production practices, there is great potential for improvement of the pigs' environment. Additional changes in the way in which condemnations are communicated to producers could play a huge role in improving the on-farm treatment of badly bitten pigs, i.e. indicate that carcasses that were condemned were also tail-bitten. Further work in this area will develop the issue of carcass condemnation as a welfare outcome for pigs, determine the costs of carcass condemnation arising from tail biting, and examine the implications of tail-directed behaviour for meat quality.

Reference

European Food Safety Authority. (2007). The risks associated with tail biting in pigs and possible means to reduce the need for tail docking considering the different housing and husbandry systems. The EFSA Journal, 611:1-13. December 2011

Weaning at 28 Days: Is Creep Feeding Beneficial?

The Pig Site, January 9, 2012

Allowing piglets access to a Phase 1 diet (creep feed) in the farrowing room for the final seven days prior to weaning on day 28 provided no sustained performance benefit, regardless of weaning weight, according to Dr Denise Beaulieu, Janice Shea and Doug Gillis of Prairie Swine Center in the organisation's latest newsletter.

Introduction

Providing supplemental feed to the piglets in the farrowing room, or creep feeding, is practised to ensure a smooth transition onto solid feed at weaning. It is assumed that even a limited intake of the creep feed will familiarise the piglet with solid feed and lessen a post-weaning growth lag by 1) increasing the body weight of piglets at weaning, 2) encouraging consumption of solid feed following weaning and, 3) adapting the gastro-intestinal tract to solid feed.

This study was initiated when the Prairie Swine Centre moved to a later weaning age (28 days). The researchers hypothesised that the benefits of creep feeding

would be more evident with later weaning. Additionally, we examined if the response to creep feeding would differ between light and heavy birth-weight pigs.

Experimental Procedures

This experiment used data from 15 weeks of farrowing (12 sows per room) at PSCI. Piglets were provided access to a Phase 1 diet (commercial) in multi-space circular feeders in the farrowing room on days 21 to 28 for the first eight farrowing rooms only. Piglets were weaned on day 28.

Each week, representing one creep treatment, the entire weaning group was weighed and pigs ranked according to body weight within gender. The 24 heaviest and 24 lightest pigs were assigned to pen, four pigs per pen. Pens were then randomly assigned to a treatment. Thus each week, there were six pens of the heaviest and six pens of the lightest pigs. Care was taken to ensure that the time between the removal of the piglets from the sow and access to feed in the nursery was the same for all piglets and all weeks.

Video cameras set up over the pens recorded individual feeder approach which was defined as a pig placing their head over and down into the feeder. Piglets were numbered on their backs for identification. To accommodate the video recording, lights were on continuously.

Results and Discussion

Piglets who had access to creep feed for the final week prior to weaning weighed 130g more at weaning (Table 1). This did not approach statistical significance however, indicating that factors other than the presence of creep feed may be responsible tor this difference (P>0.10).

All piglets lost weight during the initial 24 hours following weaning. Contrary to expectations, piglets which had not received creep feed tended to have improved growth post-weaning and feed intake was unaffected (P>0.10). Overall feed efficiency therefore, was improved in non-creep fed piglets (P>0.01).

The creep by body-weight interaction described in Table 1 (day 0, 1, and 4; P<0.05) is shown in more detail in Figure 1 for day 0 (weaning). The response to creep was greater in heavier (240g weaning weight improvement or 2.3 per cent of body weight) than lighter pigs (30g improvement or 0.5 per cent of body weight).

Table 1. The effect of weaning weight and presence of creep feed in the farrowing room on growth and feed intake in the nursery.

		Creep Feed			Weaning Weight Group				Creep *BW
Day[a]		**No**	**Yes**	**P value**	**Heavy**	**Light**	**P value**	**SEM[b]**	**P value**
Wean.	0	8.36	8.49	0.35	10.40	6.44	<0.001	0.10	0.01

wt, kg									
	1	8.24	8.33	0.49	10.15	6.42	<0.001	0.10	0.02
	4	8.56	8.61	0.75	10.42	6.76	<0.001	0.11	0.05
	7	8.88	8.96	0.70	10.71	7.13	<0.001	0.14	0.23
	14	11.17	11.04	0.67	12.73	9.48	<0.001	0.21	0.85
ADG, kg/day	0-1	-0.12	-0.16	0.36	-0.26	-0.02	<0.001	0.02	0.79
	2-4	0.08	0.07	0.43	0.07	0.08	0.040	0.01	0.60
	5-7	0.22	0.21	0.88	0.22	0.21	0.720	0.01	0.80
	8-14	0.37	0.34	0.16	0.35	0.35	0.770	0.01	0.45
	0-14	0.26	0.25	0.33	0.25	0.25	0.830	0.01	0.59
FCE, G/F	0-1	-2.51	-4.19	0.06	-5.36	-1.34	<0.001	0.59	0.33
	2-4	0.39	0.44	0.75	0.40	0.43	0.840	0.10	0.21
	5-7	0.70	0.25	<0.001	0.43	0.52	0.001	0.06	0.11
	8-14	0.89	0.88	0.92	0.81	0.96	<0.001	0.03	0.47
	0-14	0.77	0.61	0.05	0.59	0.79	<0.001	0.05	0.56

[a]Day 0 is weaning.
[b]Because of the unbalanced design the SEM was slightly different for the effects of weaning and creep feeding. The larger SEM is shown.

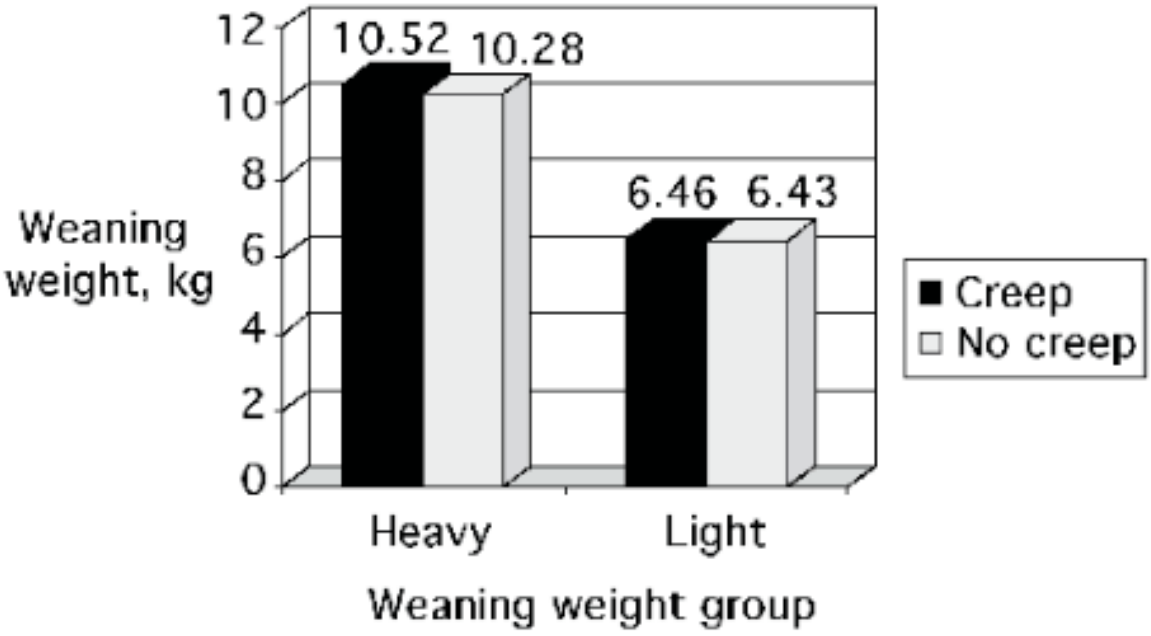


Figure 1. The interaction between weaning weight group and feeding creep in the nursery (P<0.05). Numbers over the bars are the weaning weight for the sub-group.

Results and Discussion

Piglets who had access to creep feed for the final week prior to weaning weighed 130 grams more at weaning (Table 2). This did not approach statistical significance however, indicating that factors other than the presence of creep feed may be responsible for this difference (P > 0.10).

Table 2. The effect of creep feeding in the farrowing room on the number of feeder visits in the nursery.

	Creep	No creep	SEM	P value
Day 0	6.3	8.6	0.45	0.02*
Day 1	7.0	9.1	0.32	0.04*
Day 4	7.4	8.0	0.29	0.12*

*Hour by creep, P< 0.001

Further work is underway to determine it this is because the heavier piglets consumed more creep while in the farrowing room.

Piglets who had access to creep feed in the farrowing room had fewer visits to the nursery feeder on day 0, 1 and 4 post-weaning. This pattern is most notable in the final 8 hours of each 24·hour period. Again, this is contrary to our hypothesis, that feeding creep would acclimate the piglets to solid food and thus encourage consumption in the nursery. Feed intake was comparable, thus it appears that those piglets who had received creep feed in the nursery consumed more feed after each visit to the nursery feeder. The increased visits by the pigs who hadn't received creep during the final 8 hours of each day could be because these piglets, unaccustomed to the solid feed, were consuming less feed with

each visit, and are then motivated by hunger to visit the feeder during the latter part of each day. This awaits confirmation.

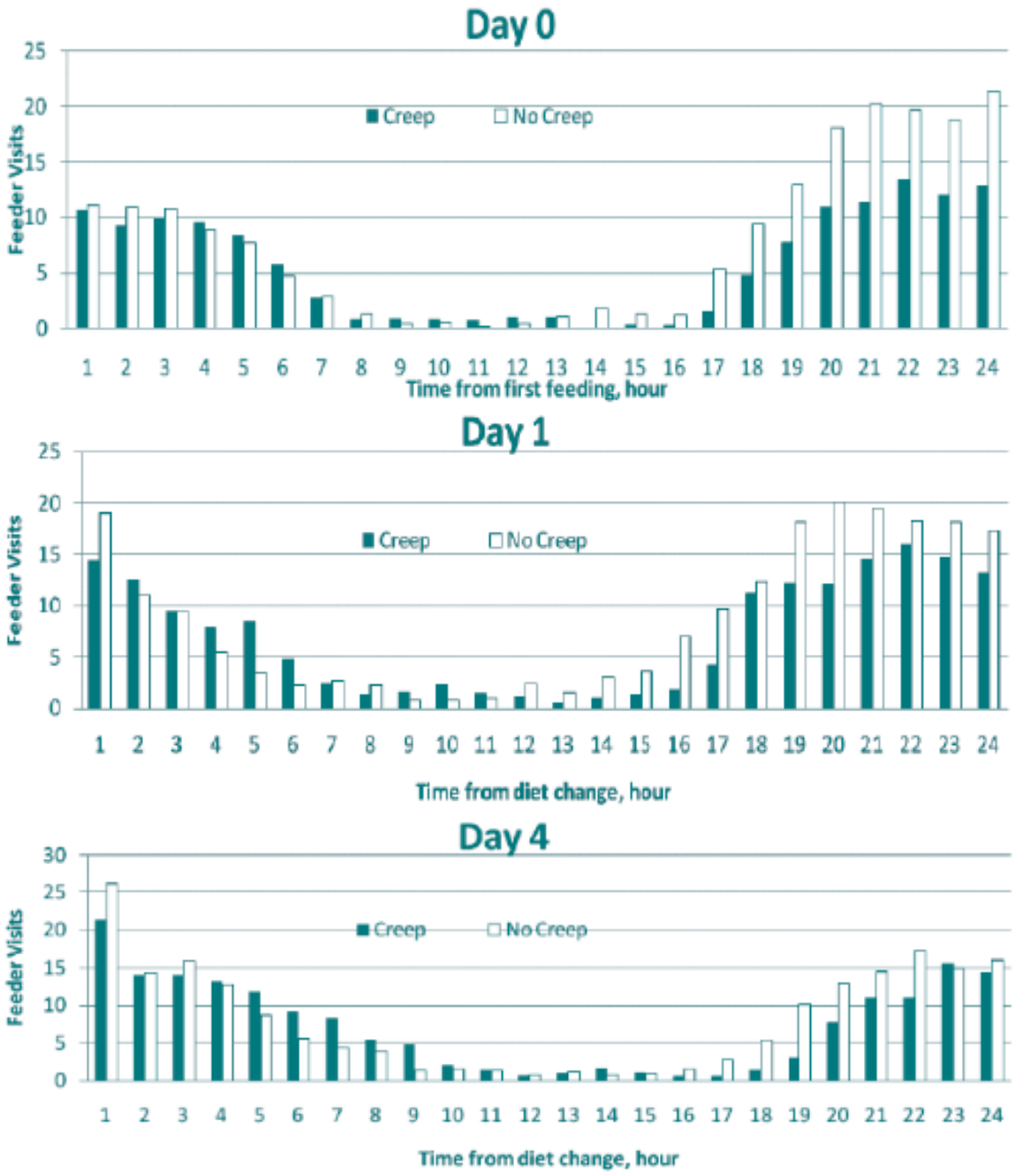


Figure 2. The effect of feeding creep in the farrowing room on feeder visits in the nursery, day 0, 1 and 4 post-weaning. Day 0 refers to the 24 hours following initiation

of feeding in the nursery, while day 1 and day 4 are the 24 hours following the morning feeding.

Conclusion

Allowing pigs access to a Phase 1 diet in the farrowing room for seven days prior to weaning had no sustained beneficial effect on performance in the nursery, regardless of weaning weight.

The Bottom Line

Research is currently under way to validate these results in a more commercial-like setting. Producers should not, however, assume that piglets would respond to creep feeding.

Acknowledgements

The authors would like to acknowledge, with gratitude, the financial support provided for this experiment by the Agriculture Development Fund, Saskatchewan Ministry of Agriculture. The authors also acknowledge the strategic programme funding provided to Prairie Swine Centre Inc. by Sask Pork, Alberta Pork, the Manitoba Pork Council and the Saskatchewan Agriculture Development Fund.

Less Bedding Can Benefit In-Transit Market Pigs

ThePigSite News Desk I updated January 04, 2012

US - In a new study, funded by the Pork Checkoff, researchers at Texas Tech and Iowa State universities found that the pork industry can generally use less bedding year-round that it currently does while improving overall animal well-being - a breakthrough finding that could save the industry an estimated $10.1 million per year.

John McGlone, a swine researcher at Texas Tech University and principal researcher for the study, along with Anna Butters-Johnson an Iowa State University researcher, looked at various rates of bedding in semi-trailers at different times of year and in different locations throughout the Midwest. This approach provided data representing cold, mild and hot weather.

Specifically, the research trials showed that groups of pigs headed to market can experience lower mortality rates in warm weather and overall improved well-being year-round when less bedding is used in transport trailers. According to Dr McGlone, the current standard in the industry is to use four bales of bedding per semi-trailer.

"During the study we found that the surface temperature of the pigs changed with the air temperature and that increased surface temperature actually caused a

negative effect on the pigs' welfare," Dr McGlone said. "In cold weather, we found that there is no added effect to using more than six bales of bedding per trailer."

Dr McGlone explained that freezing temperatures cause used, wet bedding on the trailer beds to freeze, which means pigs are more likely to slip on the ice, thereby creating more down pigs. While in warm or mild weather, they found no added effect in using more than three bales of bedding per trailer.

"We concluded that if the industry changed to using only three bales per trailer, it would create a big savings with no change in welfare," Dr McGlone said. "So it's something the industry will need to consider carefully."

Karen Richter, a pork producer from Montgomery, Minnesota, and a National Pork Board member, said, "This bedding research offers us as an industry win-win situation because the results show that we can continue to improve animal well-being practices and actually save money at the same time."

According to Sherrie Niekamp, Checkoff's director of swine welfare, the pork industry overall is doing a good job of transporting its roughly 2 million pigs per week in a safe and pig-friendly way. Statistics back up this assessment, with more than 99.3 per cent of pigs sent to market arriving in good condition.

However, the small percentage of transport losses that occur, according to previous research done by the University of Illinois, still represents a total annual industry economic hit of $46 million. This includes losses from fatigued pigs (non-ambulatory), mortalities and other losses at plants.

"We're excited about what this research can mean to the industry on many fronts," Ms Niekamp said. "It's always a good day when we can find innovative ways to continually improve how we care for pigs during all phases of production, including transportation."

According to Ms Niekamp, the Transport Quality Assurance® task force will take this new research into consideration when updating the program's transport recommendations. The current TQATM Handbook is online at pork.org.

In the meantime, Dr McGlone says producers should evaluate their current bedding practices and determine if they can implement the study's protocols. He said, "We've clearly shown there is no advantage to using more bedding than is necessary."

Millions of Piglets' Lives Can be Saved

ThePigSite News Desk I updated January 06, 2012

Hogs

DENMARK - Research results regarding feeding are being applied directly in the sow barn with the result that piglets are given a better chance of survival. This means better finances for the farmer, improved welfare for the animals and better conditions for the climate and environment.

In Denmark almost every fourth piglet dies either during the farrowing process or within a few hours or days after its birth. The good news is that many of these young lives can be saved by applying research results from Aarhus University in the feeding of pregnant and lactating sows.

This is exactly what a new project led by the feed company DLG is focusing on. The project has been granted DKK 4.5 mill. by the Ministry of Agriculture's Green Development and Demonstration Programme (GUDP).

Optimized sow feeding can help increase piglet survival rates. Scientists from Aarhus University are collaborating with the industry to apply research results directly in the pigpen. [Photo: Janne Hansen]

The project aims at optimizing sow feeding in the transition period comprising the last part of gestation and the first part of lactation. The goal is to reduce piglet mortality, minimize nutrient surplus and reduce the impact on the environment.

In the course of the project DLG will develop a new sow feeding concept that builds on knowledge created by scientists from Aarhus University. Thereafter, the Pig Research Centre will demonstrate the effect of the concept and generate new recommendations for advisors and farmers.

Research-based feeding on the farm
In the first part of the project the scientists from Aarhus University will create more knowledge about how the sow's production of colostrum and milk is improved by the new feed programme for the transition period from the last part of the sow's gestation to the first part of her lactation. This knowledge will be used by DLG to compose new nutrient packages and transition feeds so that they can act together with the scientists' new feeding strategy to provide the sows with an optimal nutrient supply.

"In Denmark and other countries sow feeding is based on what is practically viable for the feed industry and the farmer. Sow feeding is not based on what is optimal for the sow. This can have unfortunate consequences – particularly in the transition phase from gestation to lactation," said senior scientist Peter Kappel Theil from Aarhus University.

Typically, the sow will switch from gestation feed to lactation feed about one week before farrowing. She will thus be fed a lactation feed in the last part of her

gestation, in the early part of her lactation and when her lactation is at its peak. The feed's composition matches the sow's requirements at the peak of lactation but not the other periods.

The first two days of a piglet's life are the most critical and it is during this time period that mortality is at its highest. A high colostrum production is an important prerequisite for keeping the newborn piglet alive. The sow produces most of her colostrum in the week prior to farrowing which is exactly the same period in which she has to adjust to lactation feed.

The all-important fatty acids
If the sow is to satisfy her piglets' interests as well as possible, then the feeding of her at the end of her gestation and the beginning of her lactation must be changed markedly.

In a recent study the scientists found that short-chained fatty acids increase sow colostrum production. These fatty acids originate from bacterial fibre metabolism in the sow's caecum and large intestine. When the sow is subjected to a feed change it affects the bacterial metabolism. In addition, lactation feed contains less fibre than gestation feed. Both these factors affect colostrum production negatively.

"The reduced fibre content can also easily lead to constipation, which in turn can lead to farrowing difficulties," said Dr Theil.

The fibre content is but one of the factors the scientists will investigate in the new project. Earlier studies at Aarhus University have also shown that feed fatty acid content and composition affect colostrum production and that the feed dose is also an important factor.

Evaluation of Temperature Conditions in Trucks during Transport of Market Pigs to Slaughter

The Pig Site I updated December 2011

Pigs are exposed to variable temperatures during transport, according to a report by Drs Harold Gonyou and Jen Brown and others at the Prairie Swine Centre (PSC) in Canada, following studies over four seasons.

Previous research at PSC has shown there is significant variation in conditions (temperature and humidity) among different compartments in trucks transporting market pigs. This study examined conditions in truck compartments in greater depth by measuring temperature and humidity variation during transport of market pigs throughout the year. Pigs were transported from a commercial farm in Saskatchewan to a packing plant on a weekly basis, involving approximately

7.5 hours of travel. This report describes the variable conditions observed during transport in different seasons, with pigs transported in the 'belly', upper-front and middle-front compartments encountering the least favourable conditions.

Background

Transportation of pigs to slaughter involves economic losses due to deaths, 'suspect' animals on arrival at the processing plant and reduced meat quality, and raises concerns regarding the welfare of pigs. Death losses in market pigs during transport in Canada range from 0.05 to 0.17 per cent, accounting for approximately 16,000 pigs per year, with an additional 0.10 to 0.20 per cent of animals becoming non-ambulatory during transport. These losses are seasonal, with higher losses reported in summer, and vary among compartments within a truck.Previous research at PSC has demonstrated significant variation in temperature and humidity conditions between different compartments on trailers. In this study, which began in January 2010 and was completed in March 2011, PSC examined temperature and humidity conditions on a commercial tri-axle trailer to examine how conditions vary in compartments during different seasons of the year.

Animals used in this study were market pigs weighing approximately 115kg. The animals included a mixture of males (barrows) and females, and were assembled from multiple pens. All animals were from a single commercial farm in Saskatchewan. The trials were conducted on a weekly basis, beginning on 8 January 2010 and completed on 7 March 2011. The pigs were generally loaded early in the morning (approximately 04:00 am) and travelled for approximately 7.5 hours, arriving at the packing plant approximately at 12 noon. A single tri-axle livestock trailer was used for the study. Compartments in the upper deck were numbered from 1, at the front, to 4, at the back. The middle deck was numbered from 5, at the front, to 8, at the back. Compartments in the pot-belly were numbered 9, at the front, and 10, at the back. Pigs were loaded in eight of the 10 compartments. Compartments 6 and 7 were not used due to availability of pigs and load limitations. Loading density was approximately 0.41 square metres per pig (0.36 square metres per 100 kg). Temperature and relative humidity within the compartments were monitored using data logging devices (iButtons). The devices were programmed to record data at five-minute intervals. Five data loggers were mounted in each compartment, with all loggers placed 130cm above the floor to standardise the measures between compartments. The devices were suspended from the ceiling on strips of hard plastic; one was mounted in the centre of each compartment and the remaining four were placed 15cm from the centre of each wall. Two data loggers were also mounted on the truck side mirrors outside the trailer to monitor ambient conditions. To compare seasonal variation in transport conditions, four seasons were identified based on ambient temperatures at the time of departure (approximately 5:00 a.m.). Season 1 included trips where the ambient temperature was below minus 10°C (extreme cold), Season 2 included ambient temperatures from 0°C to -10°C (moderate cold), Season 3 included ambient temperatures from 0°C to 10°C (mild, above

zero), and Season 4 included ambient temperatures above 10°C (extreme, above zero). Temperatures were determined for each compartment at the time the truck left the farm (departure), and as the truck was travelling to the packing plant. The number of truck loads per each season and the average ambient temperatures (outdoors) at the time of departure from farm, during travelling, and on arrival at the packing plant are presented in Table 1.

Results

The average temperature within each compartment of the truck at the time of departure is presented. In all four seasons, temperatures at departure were lowest in the 'belly' compared to other compartments, and highest in the middle-front and upper-front compartments. During transport, compartments in the middle-front (compartment 5) and upper-front deck (compartments 1 and 2) had higher temperatures than the others in all four seasons. These compartments had relatively poor ventilation, as the front of the trailer was solid. Compartment 5 is also immediately above the truck drive wheels and transmission, which will be dissipating heat. Furthermore, previous research indicates that cool air enters at the back of the truck during transport, becoming warmer as it moves towards the front of the truck. Together these factors may have contributed to higher temperatures in the front compartments. In extreme cold conditions (Season 1), compartments in the 'belly' had the lowest temperatures, and a similar trend was found in Season. These compartments had higher ceiling heights as the compartments immediately above them were not used. Thus, extreme cold conditions in the 'belly' compartments was likely due to cool air entering from the back of the truck and the absence of pigs above them to warm the ceilings.

The Bottom Line

Pigs are exposed to variable temperatures during transport, with pigs transported in 'belly' compartments encountering lower than average temperatures, and those in upper-front and middle-front compartments encountering elevated temperatures. The effects of different boarding and insulation treatments on transport conditions during winter were examined but further analysis is needed to determine their effectiveness. The results of these studies will provide important information for improving conditions during transport, and for the direction of future research.

Biomarkers Predict Optimal Resting Time for Pigs before Slaughter

The Pig Site I updated October 27, 2011

Proteomics biomarkers can be used to predict the optimal resting time for slaughter pigs in the abattoir to alleviate the unfavourable effect of stress on the quality of pork, according to a study carried out at Wageningen University in the Netherlands.

The results show that optimal resting times differ for the various meat quality

traits and can therefore be used as management decision tools in the slaughterhouse to determine the optimal resting time depending on the requirements. In the EU-funded project Quality Pork Chains, the ABGC worked with researchers from the University of Aarhus in Denmark to develop biomarkers to monitor the effect of transport stress in order to predict the effect of resting times on meat quality traits using proteomics technology.

The experiment

The experiment was conducted in the slaughterhouse of the University of Aarhus, adjacent to the experimental farm facilities, ensuring that no transportation was required to the slaughterhouse. Forty slaughter-weight gilts were randomly divided into four groups of ten gilts. One control group was slaughtered without added stress. As a model for exercise stress during transportation, the gilts from the other three groups had to run for half an hour on a treadmill. The second group was slaughtered immediately after the exercise, groups three and four were rested for one and three hours before slaughtering, respectively. Meat quality traits were determined for all pigs. Biopsy samples were taken from the longissimus muscle (loin, LD) and the biceps femoris (BF) muscle (a leg muscle used for running, and a different muscle type). The muscle tissue was used to isolate the muscle metabolic proteome. The expression profiles were determined and associated with the meat quality traits.

Results and Discussion

Most proteomic studies have investigated the contractile apparatus of the muscle tissue. Post mortem metabolism degrades this tough system of molecules to make tender meat. The process also disrupts the cells leading towards drip loss. Balancing this process is therefore important. The metabolic proteome was investigated in this study because post mortem metabolism is responsible for the processes making tender meat from tough muscle, and thus for the balanced development of all the meat quality traits. In both muscles, associations between protein expression levels and meat quality traits were observed. The number of associations differed between the muscles, especially for traits related to energy metabolism: the BF showed more proteins with associations than the LD muscle, probably related to the activity of the muscle during exercise. The expression levels of several proteins changed during exercise and resting. Expressions were either reduced (Figure 1) or increased (Figure 2) after exercise, and resting reversed the effects of exercise for most protein levels. Some proteins showed normalised expression after one hour of rest (Figure 2), others after three hours (Figure 1), while other proteins did not return to pre-exercise levels after three hours. However, overreactions occurred too (Figure 2), indicating that resting the pigs for too long may have adverse effects on meat quality, probably due to the super compensation effect known in athletes as the trainings effect. The results of the study will be published in the August edition of the Journal of Life Sciences.

Hogs

Adequate colostrum intake critical for newborn piglets

Ceptor Animal Health News, OCTOBER, 2011

Adequate colostrum intake is considered critical for newborn piglets. The nutritional and immunological benefits of colostrum are important for piglet survival and weight at weaning. From data collected previously from Ontario swine herds, there is commonly a 10-fold difference in serum maternal immunoglobulin G (IgG) concentrations in piglets within the same litter, suggesting a large variation in the quantity and composition of colostrum ingested by littermates (1). The importance of this difference in IgG concentration on pre-weaning mortality and piglet growth has not been well studied. A pilot project was completed to investigate the relationships between birth weight, the concentration of IgG at one to four days of age, survival to weaning and weaning weight.

Two hundred piglets between one and four days of age from two farms in southwestern Ontario were weighed and had blood collected by jugular venipuncture. Farm 1 is a porcine reproductive and respiratory syndrome virus (PRRSv)-positive, Mycoplasma hyopneumoniae (M. hyo)-positive 600-sow farrow-to-finish operation. Farm 2 is a PRRSvnegative, M. hyo-positive 300-sow farrow-to-finish farm. Piglets were weaned at 22 to 29 days of age. The birth weight, sow parity, IgG concentration in serum, age at weaning and weaning weight were recorded for each piglet. To detect maternal IgG concentrations, the sera collected at one to four days of age were tested using a radial immunodiffusion assaya. The Student's t-test, linear regression, and analysis of covariance were used to examine associations between variables. Below are the main conclusions from this pilot study.

• There was a significant difference in weaning weight between piglets from sows of different parities when adjusted for birth weight, age at weaning and IgG concentrations (p-value <0.0001). However, only 20 sows were included in the pilot study and the number of sows sampled was not evenly distributed across parities.
• All 200 piglets consumed colostrum as estimated by IgG levels (minimum: 2.6g/L, maximum: 65g/L).
• The average concentration of serum IgG in piglets was not significantly different between farms (p-value = 0.73).
• The concentration of IgG in piglets that died before weaning (mean= 22.17 g/L) was not significantly different than the concentration of IgG in piglets that survived until weaning (mean 25.17 g/L) (p-value = 0.22).
• The average birth weight of piglets that died before weaning (mean= 1.36kg) was significantly less than piglets that survived (mean = 1.68kg) (p-value = 0.006).
• The IgG concentration did not significantly affect weaning weights on either farm (p-value = 0.07, r-squared = 0.0207).
• Birth weight significantly affected weaning weight on both farms (p-value = 0.0001, rsquared = 0.30).

This pilot study suggests that, on these two farms, IgG concentrations in newborn pigs were not a major determinant of survival to weaning or weaning weight. These results may reflect the small sample size (200 pigs) or the possibility that, despite the 20- fold spread in IgG concentrations, the majority of pigs received adequate immunity to protect them against the endemic challenges in their respective herds.

1. Tenbergen R, Blackwell T, Ojkic D. The Range in IgG Values in Suckling Piglets on 11 Ontario Swine Farms. Ceptor Animal Health News. Volume 18, Issue No. 3, November 2010. a RID IgG Single Subclass Test Method: IAV-CIS230 Animal Health Laboratory (AHL) Guelph, ON

Less Boar Taint by Selecting Terminal Boars

The PigSite News Desk I December 18, 2011

EU - TOPIGS will soon start selecting finisher boars which have less risk of breeding offspring with boar taint.

The technique to classify boars by their heredity characteristics for boar taint is ready to use. TOPIGS will start with the (Top Pi) Piétrain, the most used finisher boar in boar fattening.

European slaughterhouses currently discover boar taint in five per cent of the non-castrated boars. TOPIGS expects that the selection of finisher boars will result in 40 per cent less boars with boar taint.

However, boar taint is also caused by sows. TOPIGS will therefore continue with a similar research programme to classify sows by their heredity characteristics for boar taint.

If a LBT-boar is used with a LBT-sow, the percentage of pigs with boar taint can be reduced by as much as 70 per cent.

Effect of local anaesthesia and/or analgesia on pain responses induced by piglet castration

Hansson et al. Acta Veterinaria Scandinavica 2011, 53:34
http://www.actavetscand.com/content/53/1/34
Author/Organization: Monica Hansson, Nils Lundeheim, Görel Nyman and Gunnar Johansson

Background Surgical castration in male piglets is painful and methods that reduce this pain are requested. This study evaluated the effect of local

anaesthesia and analgesia on vocal, physiological and behavioural responses during and after castration.

A second purpose was to evaluate if herdsmen can effectively administer anaesthesia. Methods Four male piglets in each of 141 litters in five herds were randomly assigned to one of four treatments: castration without local anaesthesia or analgesia (C, controls), analgesia (M, meloxicam), local anaesthesia (L, lidocaine), or both local anaesthesia and analgesia (LM). Lidocaine (L, LM) was injected at least three minutes before castration and meloxicam (M, LM) was injected after castration. During castration, vocalisation was measured and resistance movements judged.

Behaviour observations were carried out on the castration day and the following day. The day after castration, castration wounds were ranked, ear and skin temperature was measured, and blood samples were collected for analysis of acute phase protein Serum Amyloid A concentration (SAA). Piglets were weighed on the castration day and at three weeks of age. Sickness treatments and mortality were recorded until three weeks of age. Results Piglets castrated with lidocaine produced calls with lower intensity ($p < 0.001$) and less resistance movements ($p < 0.001$) during castration. Piglets that were given meloxicam displayed less pain-related behaviour (huddled up, spasms, rump-scratching, stiffness and prostrated) on both the castration day ($p = 0.06$, n.s.) and the following day ($p = 0.02$). Controls had less swollen wounds compared to piglets assigned to treatments M, L and LM ($p < 0.001$). The proportion of piglets with high SAA concentration (over threshold values 200, 400 mg/l) was higher ($p = 0.005$; $p = 0.05$) for C + L compared to M + LM.

Ear temperature was higher ($p < 0.01$) for controls compared to L and LM. There were no significant treatment effects for skin temperature, weight gain, sickness treatments or mortality. Conclusions The study concludes that lidocaine reduced pain during castration and that meloxicam reduced pain after castration. The study also concludes that the herdsmen were able to administer local anaesthesia effectively.

Effect of Sow History on the Performance of Growing-Finishing Pigs

The Pig Site I November 21, 2011

Sell-Kubiak E., E.F. Knol and P. Bijma. 2011. Effect of sow history features on growth and feed intake in grow-finish pigs. Published online before print in J. Animal Science. doi: 10.2527/jas.2011-4265

Some aspects of a sow's early life affect the performance of her litter during the growing and finishing phases, according to researchers based in the Netherlands, but the effects are small.

The sow provides a specific environment for her offspring during gestation and lactation, according to Ewa Sell-Kubiak of Animal Breeding and Genomics

Centre at Wageningen University in the Netherlands and co-authors there and at the Institute for Pig Genetics in Beuningen in their paper published in Journal of Animal Science recently.

They explain that certain features in the sows' early life (sow history features) may affect her ability to deliver and feed a healthy litter. In genetics of growing-finishing traits, these effects are estimated as a common litter or permanent sow effect.

The objective of their research was to identify sow history features that affect the growth rate (GR) and feed intake (FI) of a sow's offspring during the growing-finishing stage. Data from 17,743 grow-finish pigs, coming from 604 sires and 681 crossbred sows, were recorded between May 2001 and February 2010 at the experimental farm of the Institute for Pig Genetics at Beilen in the Netherlands. The grower-finisher stage was divided into two phases (phase one: 26 to 75kg and phase two: 75 to 115kg).

The sow history features were: birth litter size, birth year and season, birth farm, weaning age, age being transferred to experimental farm, and age at first insemination. The sow features were added to the basic model one at a time to study their effect on grow-finish pigs' traits. Subsequently, significant sow features ($P<0.1$) were fitted simultaneously in an animal model.

With every extra piglet in the sow's birth litter, GR of her offspring decreased by 1g per day and FI decreased by 4g per day. Every extra day to the first insemination increased GR of grow-finish pigs by 0.1g per day.

The heritability estimates for GR and FI (only in the phase two of grow-finish stage) decreased after adding the sow features to the model.

The researchers found no differences in estimates of the common litter effects between the basic model and the model with all significant sow features. The estimates of the permanent sow effect changed for FI from 0.03 (basic model) to 0.00 (model with sow features) and for FI in phase one the permanent sow effect decreased from 0.03 (basic model) to 0.01 (model with sow features).

Sell-Kuiak and co-authors concluded that selected sow features do affect the traits of growing-finishing pigs but their estimates are small and explain only a small proportion of the differences in GR and FI of growing-finishing pigs. The sow features partially explained the permanent sow effect of FI-related traits but did not explain the common litter effect.

Although the sow early life features can affect piglets traits, they do not predict which sows produce better performing offspring in growing-finishing phase, added the researchers.

Hogs

Reference Sell-Kubiak E., E.F. Knol and P. Bijma. 2011. Effect of sow history features on growth and feed intake in grow-finish pigs. Published online before print in J. Animal Science. doi: 10.2527/jas.2011-4265

Economic and Welfare Impact of Lameness in Sows in England

The Pig Site I October 28, 2011

In a survey of UK farms in 2007/2008, four per cent of sows were found to show signs of lameness, with half of farms having at least one lame animal. The cost per lame sow was estimated to range from £19 to £266.
British Pig Executive

Lameness in pigs is a major welfare concern and one of the most commonly reported reasons to premature culling of breeding sows, according to Katriina Willgert of the UK's Royal Veterinary College in a report made available by BPEX.

The prevalence of lameness in sows was estimated from 113 English pig breeding units in 2007 and 2008, and different risk factors associated with the occurrence of lameness were examined, followed by an assessment of the economic costs of lameness in sows.

The prevalence of lameness in sows was 4.3 per cent and at least one lame sow was observed at 50.4 per cent of the 113 farms. The culling rate of sows due to lameness (3.9 per cent) was slightly lower than the prevalence of lameness in sows.

In both indoor and outdoor sows, the presence of a prevention plan for lameness at the farm significantly affected the occurrence of lameness. Farms with higher producing sows were more likely to have a prevalence of lameness of five per cent or higher.

When only indoor sows were considered, the odds of lameness occurring at the farm increased with the number of sows in the pen.

Lameness was also more likely to occur at farms where sows were housed on solid flooring than when they were kept on slatted or partly slatted flooring.

Depending on the severity of the case, the estimated cost of an initial case of lameness could range from £19 if only treatment is required to more than £266 in more severe cases where the production level is affected and euthanasia is necessary, concluded Ms Willgert.

The author added that increased awareness of the risk factors behind lameness

is essential in farm management and can be useful when designing housing areas as well as developing future prevention plans for lameness.

Assessing learning and memory in pigs

Updated 12 October 2011
Anim Cogn (2011) 14:151–173
Author/Organization: Elise Titia Gieling, Rebecca Elizabeth Nordquist, Franz Josef van der Staay Publication year: 2010

In recent years, there has been a surge of interest in (mini) pigs (Sus scrofa) as species for cognitive research. A major reason for this is their physiological and anatomical similarity with humans. For example, pigs possess a well developed, large brain. Assessment of the learning and memory functions of pigs is not only relevant to human research but also to animal welfare, given the nature of current farming practices and the demands they make on animal health and behavior. In this article, we review studies of pig cognition, focusing on the underlying processes and mechanisms, with a view to identifying. Our goal is to aid the selection of appropriate cognitive tasks for research into pig cognition. To this end, we formulated several basic criteria for pig cognition tests and then applied these criteria and knowledge about pig-specific sensorimotor abilities and behavior to evaluate the merits, drawbacks, and limitations of the different types of tests used to date. While behavioral studies using (mini) pigs have shown that this species can perform learning and memory tasks, and much has been learned about pig cognition, results have not been replicated or proven replicable because of the lack of validated, translational behavioral paradigms that are specially suited to tap specific aspects of pig cognition. We identified several promising types of tasks for use in studies of pig cognition, such as versatile spatial free-choice type tasks that allow the simultaneous measurement of several behavioral domains.

The use of appropriate tasks will facilitate the collection of reliable and valid data on pig cognition.

Watch Bedding Levels In Pig Transport

Source: Nov. 7, 2011 www.porknetwork.com

The amount of bedding present in trailers used to haul pigs to the plant can have a significant impact on animal losses, according to John McGlone, professor and animal well-being specialist, Texas Tech University. Research trials on varying levels of bedding in transport trailers were conducted by McGlone and he reported the results at the American Meat Institute’s Animal Care and Handling conference held recently in Kansas City.

“Most USDA inspectors require bedding is present on the trailer,” McGlone says. However, bedding requirements vary according to weather conditions and temperatures. To help define the optimum bedding levels required for transporting pigs in commercial settings, McGlone and his colleagues recorded multiple variables such as bedding depth present on trailers, air temperature, pig handling methods, skin temperatures and number of non-ambulatory pigs as well as those dead on arrival at the plant. In cold weather (less than 32 degrees F), the study showed there was no advantage in increasing bedding over six bales, or a depth of 1 inch, since the bedding freezes after the first load of pigs is transported.

“The bedding gets frozen solid for follow-up loads,” McGlone explains. “During very cold weather, we saw an increase in pigs dead-on-arrival in the second group of pigs transported on the same bedding,” McGlone said. “It’s a reason to avoid over-using bedding during the winter.”

Six bales provides about 1 inch of bedding on straight deck trailers 53 feet long by 102 inches wide. During warm weather transport, bedding and air temperature are additive in increasing the number of pigs dead-on-arrival, according to McGlone’s research. “Use of nine bales of bedding in a trailer during 86 degree weather resulted in a DOA rate of over 1 percent,” said McGlone. “With three bales, it was one half of one percent. Bedding can be deadly to pigs in warm weather.”

Innovation: Self-closing feeding pens for sows in group housing

Pig Progress I 18 Nov 2011

Van der Lee Stalinrichting en Voersystemen bv has developed a revolutionary system for group-housed sows. This innovation makes use of the results of the practical study conducted by Animal Sciences Group of Wageningen UR1, with which better reproduction results are stimulated.

In 2010 the practical study by Animal Sciences Group van Wageningen UR showed that one of the factors for success in the group housing of sows in feeding pens is a sufficiently wide run. Farms with a run 2.50 to 3.00 metres wide achieve significantly better reproduction results than farms with a narrower run behind the pens.

In order to be able to realise this factor for success easily without higher construction costs, Van der Lee Stalinrichting in Nistelrode, the Netherlands has recently developed a revolutionary system for sows in group housing: Pig Free(tm) self-closing feeding pens, Pat. Pend. EP 11150185.4.
Depending on the pen width, this innovation gives your sows up to as much as

30% more room to move behind the pens, with the room for the sow to lie down reduced by only 10%, this having a positive impact on the reproduction results.

Pig Free(tm) self-closing feeding pens are equipped with a unique patented self-closing swing door with a peg closure and can be extended with a central locking system. Proper closure of the door is guaranteed at all times, even with fully-grown sows in pens of 200 cm (lying down space 210 cm) and a pen width of 70 cm.

Thanks to the unique and well thought out design of the central locking system, you can supervise the sty and the sows can easily be accessed in an optimum manner.

You can obtain more information from Van der Lee Stalinrichting en Voersystemen bv - www.vanderlee-stalinrichting.nl or www.pigfree.nl

Piglets Overcoming Post-Weaning Stress

The Pig Site Newsletter I 28th November 2011

Achieving good performance in growing pigs starts with ensuring the sow produces enough milk and after weaning, pathogenic bacteria can be combatted by feeding a combination of organic acids, cinnamaldehyde and a permeabilising substance, according to Biomin.

Weaning is no doubt a challenging event in the life of a piglet. How a piglet is getting over this stressful period in its life is a matter of many different factors. The most obvious is to provide the animal with a diet sufficient in nutrients in order to make sure the nutritional needs of the piglets are met. But also factors such as weaning weight, which is closely related to the performance of the sow during lactation and the sow's milk yield, are major factors influencing the post-weaning piglet performance. Problems occurring after weaning such as diarrhoea and the post-weaning growth check are widely spread and cause severe economical losses to the livestock producer. Performance post-weaning has, for example, a strong influence on the time to reach market weight as pigs not suffering from the post-weaning growth check requiring less days to reach market weight. Post-weaning performance is a result of the weaning weight (Figure 1), as pigs that are heavier at weaning are less likely to suffer any adverse effects due to the change they are undergoing post-weaning. Weaning weight is, in turn, a result of their performance during suckling which is amongst other factors such as creep feeding also a matter of the lactation performance of the sow. The main goal during suckling is to avoid severe weight loss of the sow by maintaining optimum feed intake so that the sow is able to have optimum milk yield and, therefore, ensure optimum growth of the piglets. This is only the case if

the sow has a sufficient feed intake from day one of the suckling period. Feed intake after weaning or if the sow is eating at all also depends on the farrowing time as prolonged farrowing has detrimental effects on the welfare of the sow. A prolonged period of labour pain is associated with a slower recovery from farrowing. An exhausted sow is less reactive, which most likely leads to a reduction in post-farrowing feed intake.

Optimising Farrowing

The reasons for prolonged farrowing are diverse but most likely related to a lack of calcium, which is needed for muscle contraction. Urinary pH is influenced by the acid-base balance of the feed and has strong effects on the acid-base balance of the body. Increasing the anions of the diet results in acidic stress of the sow. Depending on the extent of acidic stress, the sow may enter a metabolic stage often referred to as metabolic acidosis. It is reported that acidic stress leads to an increase in the net excretion of calcium from the body by increasing renal calcium excretion. The body tries to compensate for this deficiency by increasing mobilisation of calcium from the bones, which is the biggest calcium storage of the body. At the same time, the body also tries to buffer the blood pH via increasing calcium resorption regulated by the parathyroid hormone and vitamin D, which results in increased calcium blood levels. As during gestation more calcium is available for the sow as it is needed, the parathyroid hormone/vitamin D mechanism is not trained, which might lead to problems during farrowing due to a lack of calcium available for muscle contractions. This mechanism can be trained by feeding anionic diets. An effective way to increase anions in the diet is by adding a mixture of an inorganic acid, anionic substances and plant extract to a diet incorporated in products such as Biomin® pHD. This increases the anions in the diet, which leads to metabolic acidosis and the release of calcium, which results in shorter farrowing and a good start for the sow into lactation.

Other Health Threats

Short farrowing times can lead to better feed intake of the sow post-weaning, which in turn leads to optimum milk yield, hence optimum growth of the piglets during suckling period and high weaning weights. Even if high weaning weights can be achieved, weaning itself still remains to be a very stressful event in the life of a piglet. Severe changes such as the change of the diet from liquid to solid, the removal of the piglets from their litter-mates as well as changes in the environment puts the newly weaned piglet under enormous stress and research has shown that it may take the piglet up to the second or third week post-weaning to consume a comparable amount of energy and grow at the same rate as prior to weaning. Especially during that time, piglets are extremely vulnerable and the immune system weakened. This means that even if the piglet was provided with an optimum start into life by a sufficient milk supply of the sow resulting in high weaning weights, health threats remain as the presence of pathogenic bacteria can cause severe harm especially in times in which piglets are vulnerable and the immune system weakened as it is the case in the time

post-weaning.

Organic Acids

Organic acids have been used in animal nutrition for decades. They not only have beneficial effects on feed, as they lower the pH creating unfavourable conditions for pathogenic bacteria, which leads to a reduced intake of pathogens by the animal. Organic acids also have antimicrobial effects within the animal's gastrointestinal tract (GIT). Also in the GIT, organic acids lower the pH, creating unfavourable conditions for pathogenic bacteria. However, organic acids in their non-dissociated form can penetrate the cell wall of bacteria. Within the bacteria, they dissociate, reducing intracellular pH. The cell tries to restore the normal pH, which is a process requiring energy. Furthermore, inside the cell, anions accumulate, which disrupts the DNA and protein synthesis and the membrane so that the bacterial cell cannot replicate. However, the antimicrobial effects of organic acids especially on gram-negative bacteria are limited, as gram-negative bacteria have an outer membrane, which serves as an additional barrier against external agents, which might damage the bacteria. Therefore, organic acids were often combined in the past with other nature-identical compounds in order to combat pathogenic bacteria more effectively.

Cinnamaldehyde

Combining organic acids with cinnamaldehyde was shown to have synergistic effects on the inhibition of pathogenic bacteria as shown in vitro. This is not surprising, considering cinnamaldehyde's mode of action as it plays a major role in cell division of potentially harmful bacteria targeting the so-called FtsZ protein. Under normal conditions, FtsZ polymerises into filaments, which assemble at the place within the cell where the cell division takes place into the polymeric structure known as Z-ring. The Z-ring is responsible for the cell division. Cinnamaldehyde inhibits not only the formation of FtsZ into filaments, but also inhibits essential processes involved in the Z-ring formation and its function. This impairs the cell division and results in a reduction of the bacterial load within the gastrointestinal tract.

Gram-Negative Bacteria

As indicated, effects of nature-identical compounds on gram-negative bacteria are limited due to their outer membrane protecting the cell from possibly harmful substances. However, weakening this outer membrane is possible by substances commonly referred to as permeabilisers. There are known to be many permeabilising substances but they act differently: some remove stabilising cations from the outer membrane, others bind to the outer membrane resulting in the loss of barrier function. Others again destabilise and disintegrate the outer membrane or displace cations from the outer membrane. However, all have the same end effect, which is to damage the outer membrane, facilitating the entry of external substances, which are capable of inhibiting or destroying cellular functions, into the cell, resulting in sub-lethal injury of the bacteria.

Influence on Growth Performance

It has been shown in vitro that a combination of organic acids, cinnamaldehyde and a permeabilising substance, launched as Biotronic® Top3 has beneficial effects on the inhibition of pathogenic bacteria. Combating pathogenic bacteria has also beneficial effects on growth performance of animals. Bacteria compete with the host for nutrients, secrete toxic compounds, decrease fat digestibility, stimulate rapid turnover of absorptive epithelial cells, require an increased rate of mucus secretion by intestinal goblet cells, and stimulate immune system development and inflammatory responses. All of these effects negatively impact growth performance. Therefore, it is not surprising that when pigs were fed a diet containing an organic acid blend, cinnamaldehyde and a permeabilising substance over a 56-day post-weaning period had a six per cent higher final body weight, ate five per cent more, had an eight per cent increased daily weight gain and a feed conversion ratio three per cent better than the control group (Table 1).

Table 1. Performance of pigs fed a diet containing a mixture of organic acids, cinnamaldehyde and a permeabilising substance compared to a control group

	Negative control	Biotronic® Top3	Change, %
No. of animals	n = 30	n = 30	
Initial body weight, kg	8.75	8.72	*I*
Final body weight, kg	35.62[a]	37.69[b]	**+6**
Feed intake, g/animal	982	1028	**+5**
Daily weight gain, g	481[a]	517[b]	**+8**
FCR	2.04	1.99	**-3**

a,b Means with different superscripts differ significantly; P<0.05

In conclusion, the first step in feeding the piglet is to make sure that the sow has an adequate milk yield, which can be achieved by making sure that farrowing is running smoothly and the sow achieves a high feed intake as soon as possible after farrowing. However, even if piglets are healthy and have a high weaning weight, the stressors they are exposed to not only around weaning but during the whole grower stage represent an enormous health threat and make it easier for pathogenic bacteria to exert adverse effects on the pig's health and associated performance. Therefore, serious effort has to be put in to effectively combating pathogenic bacteria in any case. This can be achieved by combining organic acids, cinnamaldehyde and a permeabilising substance. *November 2011*

Monitoring Pigs To Improve Welfare And Production

Source: Dec. 28, 2011 www.pigprogress.net

Hogs

Sensors, CCTV and chips find their way into the pig house for the sake of health and welfare in pigs. A new research project restructures and adapts the technology.

Pig of all ages will find it much harder in the future to keep their secrets secret. If they go to the wrong end of the pig sty to do their business, if they start to bite the tails of their pen pals, this behaviour can be recorded using state-of-the-art monitoring and registration technology – even in the dead of night. Automatic monitoring can also keep an eye on the health of the pigs. There are already a number of systems in circulation that monitor different conditions in the pig house. But they do not always speak to each other. A new five-year research project that scientists from Aarhus University participate in aims to change that. The project is coordinated by University of Copenhagen and has just received 20m DKK from the Danish Agency for Science, Technology and Innovation under the Ministry of Science, Innovation and Higher Education. The project aims to develop and improve the current information and communication technologies for the monitoring of behaviour and other aspects of the lives of young pigs to improve animal welfare and production. This will involve the use of advanced statistical and analytical methods of their management. There are currently many technological opportunities for monitoring. The room temperature, the water and feed intake of the pigs and their growth rate and activities are all factors that can be automatically monitored and recorded. This means the farmer can react at an early stage if problems arise in the pig pen. The challenge is to get the systems to talk to each other and to ensure that the farmer only needs to react on the most important information. In the new project the scientists will be developing a system that can incorporate all the information and construct a data set on individual farms. With information that is interconnected, it will be easier for the scientists to identify links between different factors.

You can, for example, link the temperature in the animal house to the incidence of diarrhoea or the animal density with the incidence of tail biting. If certain relationships appear to be stable, they can be used to prevent the incidence of new problems right down to pen level. The investigations will focus on certain phases in the life of the pig. The phases are the introduction to a new pen, the adaptation to a new pen, the growing phase, the final period before being moved or slaughtered and the move itself to a new pen or to the slaughterhouse. Some of the factors that the scientists will keep an eye on are how quickly the animals locate the water supply and the feed in a new pen, where and when incidences of diarrhoea or tail biting arise, the growth and welfare of the pigs and their behaviour in situations of rest, play, fighting, meals and excretion.

The project is a collaboration between the University of Copenhagen, who are the leaders of the project, Aarhus University, the Pig Research Centre and the private companies Skov A/S, Prosign A/S and TNM A/S.

Poultry

Relationship Between the Incidence of Ascites and Ventilation in Broiler Chickens

The Poultry Site I October 27, 2011

Feizi A. and M. Nazeri. 2011. Study of the relation between the incidence of ascites syndrome and the ventilation factor in broiler chickens of the broiler house. International Journal of Poultry Science, 10(8): 637-639.

Researchers at Iran's Islamic Azad University observed fewer problems with ascites and respiratory diseases in broilers after they improved the ventilation in seven commercial poultry houses.

In their paper published in International Journal of Poultry Science recently, Adel Feizi and Mehrdad Nazeri of the Islamic Azad University in Tabriz, Iran, explained that the main objective of their study was to determine the relationship between the incidence of ascites syndrome and ventilation factor in broiler chickens in the northwest region of Iran. They studied seven flocks that showed ascites syndrome.

They observed unsuitable ventilation conditions in all seven poultry houses. Increasing the inlet area and ventilation rates, while also setting maximum ventilation rates for the summer and minimum rates for the winter, the incidence of ascites syndrome decreased to between one and 1.5 per cent from between 4.0 and 7.5 per cent previously in all seven poultry houses. Furthermore, Feizi and Nazeri report that the prevalence of chronic respiratory disease (CRD) complex also fell after the ventilation adjustment – from between five and eight per cent to no more than 3.5 per cent.

The Tabriz researchers commented that their study confirms carbon dioxide and oxygen contribute significantly to the incidence of ascites under unsuitable ventilation and it is possible to decrease the incidence rate of ascites by correction of the poultry house conditions.

Breeder chickens show different behaviors

World Poultry I 04 Oct 2011

Behavior patterns for animals develop early in life. Environmental conditions play a significant role in development of social hierarchies. Some aggression is necessary.

However, when female chickens are fearful, they tend to remain on slatted areas. If they do leave the slatted areas, they are often repeatedly mated by several males. This can result in injury or death.

Research on this matter was carried out by the University of Arkansas in Fayetteville, AR, USA.
According to researchers S.M. Sullivan and N.B. Anthony, behaviorists contend that years of cage rearing and artificial insemination of elite populations without selection for behavior traits has caused a failure for males to perform enough courtship behaviors and a failure for females to properly respond by crouching.

Many of the factors that affect rate of mating are; dominance, ratio of male to females, specific breed differences, space, accessibility of males to females, how tolerant individual males are to other males, individual differences in libido, learned behaviors and conditioned responses.

Recorded were 26 different behaviors. These behaviors were then combined into 3 aggressive categories and 1 non-aggressive category. It appeared that more aggression occurs at 20% production than at 50% production.

There were differences between male lines and between time periods. There were no differences of individual aggressive behaviors for production periods except for circling (perhaps a precursor to waltzing). Fertility of lines A x White Rock started high and remained high, lines A x A and White Rock x White Rock started high, dropped significantly, and then returned. Mortality of males was the highest for A males crossed on White Rock females.

Interestingly, there were no mortalities for males crossed on the A female line. The female affect on male aggression is quite evident. There are differences due to hen effects among all lines. Best fertility at 20% production in lines crossed with each other and lines crosses with White Rock males. There appear to be minimal differences between commercial broiler lines crossed on White Rock lines, apart from some individual aggressive behaviors.

Addressing the Challenges of Alternative Housing Systems for Poultry
The Poultry Site I November 4, 2011

Welfare concerns about conventional intensive poultry systems stimulated the development of the new so-called 'alternative' housing that is becoming more popular in developed countries. It is clear that these new systems do not automatically deliver better bird welfare but present producers with new challenges, writes Jackie Linden, senior editor of ThePoultrySite.

The symposium 'Alternative Systems for Poultry – Health, Welfare and Productivity', organised by the UK Branch of the WPSA and held in the Scottish city of Glasgow in September, attracted participation from more than 120 delegates from 26 countries, such is the current interest in this topic across the

world and the importance placed on research in this area.

Development of Furnished Cages for Laying Hens
"Directive 99/74/EC has made the biggest impact on animal welfare in the EU in the shortest time"

"Directive 99/74/EC has made the biggest impact on animal welfare in the EU in the shortest time," said Arnold Elson of ADAS Gleadthorpe in the UK in the introduction to his presentation, which was prepared with Dr Ragnar Tauson of the Swedish University of Agricultural Sciences.

The majority of hens have been – or will be – moved to furnished cages (FC) as a result of the Directive, which comes into effect on 1 January 2012, he said, increasing production costs. In fact, FC were conceived more than 30 years ago when welfare deficiencies of barren conventional cages were realised. Their use was intended to enhance hens' behavioural repertoire and welfare without the disadvantages of non-cage and extensive housing.

Since then, their design has been refined and improved, resulting in much improved performance and hen welfare. With 750 square centimetres per bird, FCs offer hens more space than conventional cages, as well as perches, nest boxes and a scratching area, in addition to the feed trough and drinkers.

Group size has been an important consideration, said Mr Elson, especially in relation to variation in damaging pecking in differing genotypes, with or without beak treatment. Regulations on beak trimming vary from country to country and have affected cage design, group size and management.

The trend has been to move from small group FCs – used mainly in Scandinavia – to larger group medium and large FCs subsequently developed in other countries, with the majority of birds in groups of up to 60 birds. FCs are have been estimated to increase production costs by about eight per cent over conventional battery cages.

The group sizes have generally performed well under good management, said Mr Elson. Interventions such as beak trimming and controlled light intensity are most often applied in FCLs and to brown genotypes.

Large-scale studies, in which performance and welfare have been compared across all currently available systems, enable us to conclude that they are at least as good in FCs as in any other system and probably superior.

Council Directive 19999/74/EC, which requires the demise of all conventional cages in the EU by January 2012, has accelerated the move into FCs and it is clear that the majority of laying hens in Europe will be housed in them for the

foreseeable future, with the aim of enhancing laying hen welfare.

FCs have potential for further development as research reveals more information of optimum group/cage sizes, the provision of litter, the elimination of red mites and ways to reduce feather pecking and cannibalism, concluded Mr Elson.

Comparison of Production, Health and Welfare of Hens in Cages and in Alternative Systems

"The right birds for the right systems"
Bas Rodenburg of Wageningen University in the Netherlands made the focus of his paper a comparison of the performance, welfare, health and hygiene of laying hens in different types of non-cage systems, focusing on barn, free-range and organic systems. In a paper written with Drs K. De Reu and F.A.M. Tuyttens of the Belgian Institute for Agricultural and Fisheries Research, he contrasted non-cage systems with each other and with cage systems. He concluded that large differences have been identified, both between and within systems.

Moving from conventional cages to furnished cages, barn, free-range and organic systems results in increasing environmental complexity, he said, which is positive for some aspects of hen welfare but also increasing risks for performance, health and hygiene, which may be negative for other aspects of hen welfare.

For the improvement of hen welfare in non-cage systems and furnished cages, Dr Rodenburg recommends that the focus should be on creating a better match between the animals and their environment. Good examples are the development of new housing designs, such as the Rondeel and Plantage, which combine the benefits of non-cage systems with improved performance, health and hygiene status.

He concluded that further, promising approaches in animal breeding and optimised rearing environments will yield major improvements in the welfare of laying hens in non-cage systems and furnished cages.

"The right birds for the right systems" is key, Dr Rodenburg said in summing-up.
Housing and Management of Broiler Breeders and Turkey Breeders

Feed restrictions in Broiler Breeders

ThePoultrySite
The symposium 'Alternative Systems for Poultry – Health, Welfare and Productivity'

"The restricted feeding regime during rearing is generally seen as one of the major welfare issues in broiler breeders"
Dr Ingrid de Jong

Housing and management of broiler breeders and turkey breeders in Europe were described by Dr Ingrid de Jong of Wageningen University for broiler breeders and turkey breeders were covered by Tim Burnside of Aviagen Turkeys, standing in for his colleague, Dr Magnus Swalander.

The majority of broiler breeders in Europe are the standard, fast-growing genotype but 18 to 20 per cent of the birds are dwarf parental females that produce standard and alternative (medium- or slow-growing) broilers, said Dr de Jong.

Broiler breeder housing systems are very similar: birds are generally kept in climate-controlled houses with litter floor during the rearing period and partially slatted floors during the production period. There is a low percentage of birds in cages and alternative systems are not used. Males and females are reared separately until 18 to 21 weeks of age and then transferred to he production farm where they are housed together until 60 to 65 weeks of age.

The restricted feeding regime during rearing is generally seen as one of the major welfare issues in broiler breeders as it leads to chronic hunger and frustration in feeding motivation. Aggressive behaviour of the males towards the females at mating was also mentioned by Dr de Jong as a concern, which can be partly alleviated by lower stocking density.

The majority – more than 95 per cent – of turkey breeders in Europe are of either heavy or heavy-medium genotype with white plumage, explained Dr Burnside. The remainder of the turkey market consists of small strain white or coloured birds for whole bird seasonal production. Both conventional large-strain turkeys and small strain traditional turkeys are used for outdoor/alternative production systems.

Rearing of breeding turkeys is floor-based on deep litter and predominantly in environmentally controlled housing. Males and females are reared separately until 29 weeks of age and then transferred to the laying facility. Male parent stock id selected at 16 to 18 weeks of age, paying attention to health, fitness, plumage and conformation.

Laying facilities are either open-sided houses or controlled-environment houses for breeding females and typically environment-controlled housing for breeder males. Breeding turkeys are kept in production until 56 to 60 weeks of age, i.e. 24 to 38 weeks of production. Quantitative feeding restriction is applied to breeder males from selection to the end of production to maximise fitness and production. Breeder females are fed unrestricted throughout rearing but a lower

protein diet to avoid the hens becoming fat. Injurious pecking is generally seen as the mot important welfare issue in flocks where beak trimming is not applied.

"Welfare is a key priority for breeders and the industry," concluded Dr Burnside.

Housing and Management of Layer Breeders in During Rearing and Production

ThePoultrySite
The symposium 'Alternative Systems for Poultry – Health, Welfare and Productivity

"Floor eggs need to be collected regularly – several times a day, if necessary"

Housing and management of layer breeders need to be right, otherwise farmers are unable to take advantage of the genetic potential and high economic value of the hens, said Dr Hans-Heinrich Thiele of Lohmann Tierzucht in Cuxhaven, Germany.

He explained that a good start is secured by optimal brooding conditions, high feed quality and appropriate management in the early life of chicks.

The development of adequate eating capacity during the later rearing period and a fine-tuned light stimulation were factors that he identified as important for a good start in the production phase.

Dr Thiele stressed that the birds must be adjusted to the different housing systems for layer breeders; they need to be trained to be able to access easily the feed, water and nest boxes provided, and the correct vaccination schedule will prepare the birds for the different disease challenges they face in the production environment.

Once in production, nutrient requirements can be met by a phase feeding programme. Good hatching egg quality can be achieved by avoiding floor eggs and appropriate egg handling.

Dr Thiele offered a number of tips to prevent floor eggs, including ensuring easy access to all the nests without dark corners or draughts. Some lighting in the nests may help, he suggested, as does water provided near the boxes and barriers to prevent more dominant birds from excluding the others from that area. Excessive litter should be avoided on the floor. Also important, according to Dr Thiele, are to ensure birds are not disturbed while they are laying and to collect any floor eggs regularly – several times a day, if necessary.

Poultry

Alternative Systems for Meat Chickens and Turkeys

Legislative and assurance scheme requirements for standard and alternative indoor and outdoor broiler and turkey production systems were described by Dr Tracey Jones of welfare campaigners, Compassion in World Farming, in a paper co-written with Dr Jutta Berg of the FLI in Celle, Germany.

She explained that health and welfare are protected to various extents by a series of input requirements, which cover stocking density, light, environmental control parameters, environmental enrichment, permitted mutilations and growth rate. Outcome measures, on the other hand, are usually related to physical well-being and tend to highlight flocks that performed poorly. Success depends on the effectiveness of the input and output measures, the reporting structure and remedial action taken.

Alternative systems represent a low market share of broiler and turkey production in the EU – approximately 10 and 30 per cent, respectively – and generally, production costs are higher, said Dr Jones.

Free-range and organic systems are perceived as having the potential to provide good living conditions and reduce environmental pollution, she continued, but concerns have been raised over bird health (Campylobacter infection), welfare (higher foot lesions and breast blisters and lack of outdoor ranging), product quality and consumers' willingness to pay.

Research shows that breed suitability is one of the most important factors determining welfare in alternative systems, particularly for broiler chickens. Dr Jones recommended that more robust and hardy breeds with lower growth rates should be used as these birds are better suited to a wide range of environments and perform well on less energy-dense diets.

The quality of the diet, particularly in relation to essential amino acids and protein balance and the free-range environment (particularly in relation to natural cover outdoors) are also highly important for both broilers and turkeys, she said.

The meat from slow growing broiler breeds is more suited to the whole bird market (as opposed to portioned or further processed) and generally contains less fat and more protein than from conventional breeds, according to Dr Jones. Consumers tend to be unable to differentiate chicken products from alternative system by odour and taste but can differentiate by appearance and texture.

"Alternative systems can deliver," concluded Dr Jones, adding that breed suitability and the quality of the outdoor area are important considerations. For the future, she highlighted the need to focus on balancing organic diets to reduce feather pecking and a need for clearer labeling so consumers can make informed decisions about their purchasing of poultry meat.

Poultry

LED lighting for poultry

Despite initial costs, LED lighting pays in the long term ; Colour has a big impact, as red increases egg laying while green or blue calms the birds

Ontario Farmer, Tue Nov 22 2011 Page: B7 Section: Poultry

Byline: BY JIM ROMAHN ONTARIO FARMER

London -Four speakers touted the benefits of LED lighting for poultry during the Poultry Innovation Conference here recently.

They are initially more expensive, but soon reduce electricity bills enough to more than cover those costs, the speakers said they have learned from research.

They are also considered better than fluorescent lighting, including cold cathode fluorescents.

There are, however, considerable quality differences among brands and the light spectrum can be adjusted with LED lighting, so not all are the same.

John Lacham of Glo Lighting at Surrey, United Kingdom, recommends monochromatic LED lighting, based on a number of research trials testing LED lighting with greater emphasis on parts of the spectrum, such as more red or more green.

Red elicits greater bird activity, brings on sexual maturity faster and maintains peak egg laying longer. Green calms birds, they consume less feed and might have slightly better meat conversion in broiler flocks.

But green and blue may calm birds too much and red excite them too much. For example, Lacham is convinced that birds peck each other because red triggers a pecking response learned from nature where it helped them spot worms, which they needed to be quick to pick up.

"It's not cannibalism, as we have always thought. It's a natural response to red," Lacham said, adding that trials indicate a cannibalism problem in a flock can be stopped within days by reducing red-spectrum light intensity.

He said broiler catching crews seem to think the birds can't see in blue light and that's why they're calm enough to be caught when there's enough blue light for the catchers to see them.

In fact, he says, birds can see better than humans in blue light, but it's associated with sunset and so they calm down, readying for sleep.

Although LED lighting could be adjusted during the day to bring up activity, then

calm the birds down, Lacham said he recommends monochromatic LED lighting, which is full-spectrum, balanced white lighting.

He said the intensity of lighting should, however, be started low in the morning and gradually increased to simulate sunrise and gradually reduced in the evening to simulate sunset. He said that's much better than stressing the birds by suddenly flicking barn lights on and off.

As morning light intensity increases, he said the birds will eat, then drink, then eat again. After a couple of weeks of this sunrise-sunset lighting regime, they will eat in the late afternoon before preparing for sleep.

Lacham's company manufactures a LED light bulb so durable that he crashed it down on the podium and said staff often kick them around like soccer balls. They are also waterproof.

They will withstand poultry barn conditions for many years, he said, adding that major light-bulb manufacturers don't like this because LED lights will reduce their sales.

JULIE BAILEY, an energy-conservation engineer with the Nova Scotia Department of Agriculture, related the experiences of three poultry farmers, two of them frustrated with the poor performance of fluorescent lights and pleased with LED lighting.

The third farmer has reduced his electricity bills by 16 per cent by switching from traditional incandescent bulbs to cold fluorescents.

Sue Sullivan of the University of Arkansas also said LED lighting has proven better than incandescent or fluorescent and said bulb disposal was expensive, costing the university $625 to dispose of about 500 bulbs when the barn was switched to LED lighting. The issue is mercury, a hazardous waste, in the fluorescent bulbs and the nearest disposal company was far away and demanded $250 per service call.

Mikayla Baxter of the University of Guelph said trials with LED and cold fluorescent lighting indicated there are major energy savings with both, but disposal is an issue with fluorescents.

Her trials showed the same results as Lacham -increased activity and egg production under red-spectrum lighting, calmer birds under green-spectrum lighting.

Poultry

Effect of Varying Light Intensity on Welfare Indices of Broiler Chickens Grown to Heavy Weights

Olanrewaju H.A., W.W. Miller, W.R. Maslin, S.D. Collier, J.L. Purswell and S.L. Branton. 2011. Effect of varying light intensity on welfare indices of broiler chickens grown to heavy weights. International Journal of Poultry Science, 10 (8): 590-596.

Low light intensities used commercially to reduce hyperactivity, pecking damage and energy costs in broiler production did not compromise the welfare of the birds, according to researchers based in Mississippi.

The effects of varying light-intensity on ocular, immune, fear and leg health of broiler chickens grown to heavy weights under environmentally controlled conditions were evaluated by H.A. Olanrewaju of the USDA Agricultural Research Service's Poultry Research Unit in Mississippi state and co-authors there and at Advanced Animal Eye Care in Starkville and at Mississippi State University.

In a paper published in International Journal of Poultry Science, the researchers report four identical trials conducted with two replications per trial. In each trial, 600 Ross 308 chicks were randomly distributed into 10 environmentally controlled chambers (30 males and 30 females chicks per chamber) at one day of age. Each chamber was randomly assigned one of five light intensities (25, 10, 5, 2.5 and 0.2 lux) from 22 to 56 days of age. Feed and water were provided ad libitum.

Humoral immune response was determined on day 28, while ocular health and general well-being assessments were performed on days 42 and 49, respectively.

Results indicated that total Anti-Sheep Red Blood Cells (SRBC) antibody was not significantly ($p>0.05$) affected by the treatments but there was significant ($p<0.05$) sex effects under 25 and 2.5 lux treatments.

There were no differences between treatments for either ocular weight relative to bodyweight, ocular assessments, gait scoring test or tonic immobility responses, suggesting that these levels of light intensities did not compromise welfare of the birds.

This study shows the positive impact on profits to commercial poultry facilities that are using low-lighting environment to reduce hyperactivity, pecking damage and energy costs, without compromising the welfare of the broilers.

Also, the results imply that sex represents a significant contributor of variation in levels of humoral immune response in broiler chickens, reported the researchers.

Poultry

Incubation Can Affect Broiler Leg Strength

Bone characteristics, serum calcium levels, early growth rate and later leg weakness could be affected by commonly used incubation programmes, according to P.J. Groves and W.I. Muir of the Faculty of Veterinary Science at the University of Sydney in their paper presented at the 2011 Australian Poultry Science Symposium.

Summary
Leg weakness in broiler chickens remains one of the major animal welfare concerns for the poultry industry worldwide, according to P.J. Groves and W.I. Muir. Recent research has indicated possible effects of incubation conditions on the skeletal integrity of the growing birds. A serendipitous finding of a field occurrence of leg weakness allowed them to target some incubation condition variations which may have been associated with this. While an attempt to reproduce the same condition experimentally (higher temperature (0.5°C) and lower humidity (three to four per cent relative humidity) was not entirely successful, the researchers were able to demonstrate repeatable effects on bone characteristics and leg strength in broiler chickens hatched from eggs incubated under higher (0.5°C) temperature conditions. These conditions fell within the range normally acceptable for commercial broiler egg incubation.

Introduction
The aetiology of the various forms of leg weakness and lameness in the modern broiler chicken are complex, including factors relating to genetics, nutrition, infection, management and environment. The consequences for the individual bird affected and also for a considerable proportion of some flocks are serious. Bradshaw et al., 2002 stress that the welfare implications of broiler leg weakness include pain, frustration (inability to walk), reduced ability to eat and drink and consequent risk of dehydration or starvation. Birds which have difficulty in moving are also more at risk of excessive disturbance by other birds (Buijs et al., 2010) which can disrupt their sleep/rest patterns. Immobile birds are also more prone to skin damage from scratches which may result in cellulitis and death. The underlying genetic basis associated with leg weakness is under investigation (as evidenced by Butterworth et al., 2003). Major broiler breeding companies are attempting to address many of the leg weakness issues but this requires years of genetic selection, the results of which may not be seen in the commercial broiler for many years (Elfick, 2010; Hardiman, 2010). In the meantime, broiler producers can ameliorate the prevalence and severity of leg problems by attention to nutritional, managerial and environmental risk factors. A new area which is emerging as another possible contributor to the incidence of leg weakness problems is variation in egg incubation conditions. Research into fine-tuning incubation may provide additional management opportunities to further suppress the incidence of leg weakness and lameness.

A short review of leg weakness in broiler chickens

Lameness and leg weakness are considered a serious welfare problem. A plethora of lameness conditions in chickens exist. Bradshaw et al. (2002) summarised these into:

- infectious causes (bacterial chondronecrosis with osteomyelitis (so-called femoral head necrosis), tenosynovitis, and infectious stunting syndrome)
- developmental issues (varus-valgus deformity, tibial dyschondroplasia, rickets, chondrodystrophies and spondylolisthesis), and
- degenerative problems (osteochondrosis, epiphyseolysis, degenerative joint disease, ruptured gastrocnemius tendon and contact dermatitis).

Apart from the obvious clinical entities listed above, difficulty with locomotion is observed in birds which lack visible deformities and it has become conventional to assess the locomotory ability of birds and flocks using a standardised 'gait scoring' technique as described by Kestin et al. (1992). A wide ranging study using gait scoring as its basis in the UK suggested that 27.6 per cent of broilers had poor locomotory ability and 3.3 per cent were unable to walk at all (Knowles et al., 2008). Many studies have not gone any deeper and the underlying pathology is often not identified. Bradshaw et al. (2002) suggested that bacterial chondronecrosis, contact dermatitis (pododermatitis) and varus-valgus deformity were the most common conditions involved. In most broiler flocks approaching slaughter age, many or all of the described conditions will be present at varying prevalence. A detailed description of each of these conditions is beyond the scope of this paper but risk factors believed to be involved with the occurrence of the more commonly seen conditions will be summarised.

Rickets describes a condition of inadequate bone mineralisation classically induced by inadequate nutritional levels of calcium, phosphorus or vitamin D3. While broiler nutrition today is well catered for in the provision of a balance of nutrients, the occurrence of conditions which appear rickets-like (soft bendable bones and beaks) is seen commonly in young chicks. Clinical rickets can be seen following occurrences of infectious stunting syndrome (ISS) in flocks, relating to poor absorption of nutrients associated with indigestion induced by the group of viruses. ISS immunity is poorly understood and although the flock condition occurs sporadically, the viruses involved should be expected to be widely present in the broiler environment. One wonders about the possibility that subclinical ISS in many flocks may play a part in subsequent skeletal problems on a wide scale.

Tibial dyschondroplasia (TD) is a disruption of normal ossification as bones grow. An interference with adequate blood supply in the metaphysis of the tibiotarsus results in insufficient nutrients reaching the growth plate and a cartilage plug forms which fails to be ossified. Bones are subsequently weak, may bend and cause considerable pain in weight bearing. Genetics, incorrect electrolyte balance in feed and mycotoxins have been implicated in TD development. It is a commonly seen entity in broilers and is often correlated with an imbalance of the

calcium:phosphorus ratio in the feed, compounded by the difficulty in predicting real available phosphorus levels from available ingredients with and without phytase supplementation. It is quite feasible that the presence of earlier degenerative conditions, especially rickets-like conditions, may predispose birds to the appearance of other conditions later in the flock's life. In the field, rotated tibia is becoming one of the major leg deformities seen. The aetiology of this condition is not known but early rickets may be a predisposing factor (Crespo & Shivaprasad, 2008). Thorp (2008) also implicated the earlier occurrence of rickets or dyschondroplasia with varus-valgus deformity. Many of the leg weakness conditions can be modified by management and environmental conditions. Field and laboratory studies, however, are sometimes contradictory in the effects observed.

Stocking density has often been implicated with an increased incidence of leg problems (Knowles et al., 2002; Bradshaw et al., 2002; Petek et al., 2010) while other studies have shown leg problems to peak at intermediate levels rather than higher stocking densities (Buijs et al., 2009; Hepworth et al., 2010), or to not be related to stocking density at all (Dawkins et al., 2004). Lengthy photoperiod has also been incriminated with a higher incidence of leg weakness (Brickett et al., 2007; Bradshaw et al., 2002; Knowles et al., 2008; Petek et al., 2010) as has lack of exercise (Cooper and Wrathall, 2010; Sherlock et al., 2010) which has a relationship to scotoperiod (the length of the dark period). Many relate the primary risk factors to growth rate (Knowles et al., 2008, Bradshaw et al., 2002; Sherlock et al., 2010). Maintenance of dry litter conditions also can have major effects on pododermatitis (Sherlock et al., 2010). Modification of these factors can lead to better outcomes for broiler leg health. More recent work, including that reported herein, has demonstrated associations of variations in incubation conditions and subsequent leg strength and this will be summarised below.

Links to incubation condition

Recent published reviews and research have implicated defects in incubation as possible contributors to some bone irregularities in broiler chickens or turkeys. Spraddle legs in broilers have been associated with high humidity during incubation (Crespo & Shivaprasad, 2008), and Genin et al. (2008) implicated cyclic overheating during the first eight days of incubation in the later incidence of tibial dyschondroplasia via an effect on growth plate hypoxia. Oviedo-Rondon et al. (2008) showed that pre-heating conditions of eggs prior to incubation could affect bone characteristics of chicks at hatch and the incidence of twisted legs as late as 40 days of age. These authors also described effects on bone development and characteristics following early cool and/or late high temperature profiles and low oxygen tensions used during parts of the incubation process. Soft tissue effects have also been seen. In further experiments, Oviedo-Rondon et al. (2010) demonstrated an effect of an early low and later high incubation temperature profile in producing thinner gastrocnemius tendon fibres and differing collagen banding patterns during subsequent growth. The temperatures used in these studies though were outside the normal realms of incubation

practice (36°C and 39°C).

The local field observations have suggested a possible effect of incubation differences on subsequent leg strength and these will be discussed below. Commercial hatcheries run differing incubation profiles depending on their machine type and whether these run as single or multi-stage incubation. Multi-stage incubators target a single temperature and humidity profile usually between 36.9 and 37.2°C and relative humidity between 51 and 65 per cent. Single-stage commercial incubation uses a decreasing temperature profile starting at 38°C and decreasing to 37.2°C by 18 days with relative humidities varying between 50 to 58 per cent and sometimes as wide as 30 to 65 per cent. The experimental profile used in these studies was within these commercially used bounds and basically employed a higher temperature (0.5°C) over later incubation, a lower relative humidity (three per cent) between days 7 to 18, and a pulse reduction in temperature at day 6 of 1°C. The objectives of this research were to determine whether the variation in incubation conditions described generated a higher incidence of early bone weakness in newly hatched chicks and to then evaluate if later skeletal deformities or leg weakness could be associated with the incubation profile.

Materials and Methods

Experiment 1 used 2,000 and in experiment 2, 560 fertile eggs from breeders of a fast feathering dam line. In each experiment, the eggs were randomised between two incubators. The incubators were set to operate differently up to 18 days of incubation as shown in Figures 1 to 4. The major intended differences were an approximate drop in temperature of about 1°C for one day at six days of incubation, a higher continuous temperature from seven to 18 days of incubation (0.5°C) and a lower relative humidity (three per cent) throughout. These settings were based on an observed field situation where chicks with poor bone quality at hatch were produced, compared to an 'ideal' incubation profile as the control (Jan Meldrum, personal communication). From 18 days of incubation, all eggs were transferred into a common incubator set at 36.9°C and reduced by 0.3°C per day until day 21. Temperature and humidity data loggers (AZ 8829) recording conditions at hourly intervals were placed in each machine amongst the eggs.

At hatch, 44 randomly selected chicks from each incubator group were blood sampled for serum calcium and phosphorus levels and then humanely euthanised and both femurs were collected for bone ash analysis. Remaining chicks were placed in floor pens (240 birds per large pen in experiment 1 and 45 birds per smaller pen in experiment 2) and grown on commercial broiler starter and finisher rations (0-21 days and 22-42 days respectively) supplied by Millmaster Feeds, Enfield, New South Wales. At two weeks of age, 40 or 44 birds were randomly selected from each group, blood sampled for serum calcium and phosphorus levels and humanely euthanised. The proximal ends of their left tibiae were longitudinally sectioned and the epiphyseal growth plate measured at the midpoint of the bone with a digital calliper. The left femurs were collected for

bone ash analysis.

At day 28 in experiment 1, 44 birds were randomly selected and euthanised. The proximal end of their left tibiae were sectioned longitudinally and scored for the presence of tibial dyschondroplasia (TD) lesions (on a scale of 0 to 4, where 0 = no lesion and 4 = large lesion spanning the entire growth plate). At six weeks of age, 40 or 50 randomly selected chickens from each group were submitted to a Latency-to-Lie (LTL) test (first described by Weeks et al., 2002 and modified by Berg and Sanotra, 2003) for a maximum of five minutes. In experiment 1, a random sample of 30 birds per pen was weighed at 14, 21, 28, 35 and 42 days. In Experiment 2, all birds were weighed on a pen basis at 7, 21, 28, 35 and 42 days. Where data were normally distributed, comparisons were made using Analysis of Variance (ANOVA) where independent variables included incubator and sex and were compared across both experiments. Where data were not normally distributed, the Mann-Whitney U test was used to separate main effect means. LTL tests were compared using Kaplan-Meier Survival Analysis.

Results

The incubation temperature and relative humidity profiles recorded by the data loggers in each machine (actual) compared to the intended profiles are shown respectively in Figures 1 to 4. In experiment 1, the control incubator ran slightly cooler than intended and its humidity was not well controlled. In experiment 2, intended temperatures were much better matched but humidity was lower than intended and similar in both incubators.

At hatch, chicks from the test incubator profile delivered consistently and significantly lower femoral bone ash percentage and higher serum calcium levels than the control profile (Table 1). Moisture loss from both test treatments was significantly higher (Table 1). In experiment 1, in which the test treatment maintained a three to four per cent lower relative humidity, the serum calcium was lower than the serum phosphorus for both control and test treatment (Table 1). At two weeks of age, serum phosphorus exceeded serum calcium in all four groups but this ratio was again consistently higher for experiment 1. At two weeks, there was a significant interaction for bone ash percentage between the two experiments (Table 2), indicating a different response in this parameter under the differing incubation conditions that actually occurred in the incubators.

Table 1. Hatch measurements

Incubator group	Total hatchability (% ± SE)	Egg weight loss to day 18 of incubation (% ± SE)	Femoral bone ash (% ± SE)	Serum Ca (mmo l/l ± SE)	Serum P (mmol/l ± SE)
Exp 1 Control Exp 2 Control	67.92 ± 5.74 77.8 ± 4.02	9.45 ± 0.14 10.12 ± 0.26	26.9 ± 0.63 28.3 ± 0.40	1.97 ± 0.04 2.17 ± 0.04	2.31 ± 1.32 1.22 ± 0.03
CONTROL MEAN	**72.86**		**27.4A ± 0.38**	**2.01B ± 0.03**	**1.93 ± 0.85**

Exp 1 Test Exp 2 Test	71.28 ± 1.11 75.1 ± 2.75	10.28 ± 0.14 11.17 ± 0.27	25.3 ± 0.63 27.5 ± 0.28	2.10 ± 0.04 2.28 ± 0.02	2.30 ± 1.25 1.35 ± 0.03
TEST MEAN	**73.19**		**26.1B ± 0.43**	**2.16A ± 0.03**	**1.97 ± 0.82**
P=			0.04	0.002	0.87

Table 2. Measurements at two weeks of age

Incubator group	Bird weight (g ± SE)	Tibial growth plate width (mm ± SE)	Femoral bone ash (% ± SE)	Serum Ca (mmol/ l ± SE)	Serum P (mmol/l ± SE)
Exp 1 Control Exp 2 Control	401 ± 5.55 393 ± 5.66	2.05 ± 0.05 2.16 ± 0.08	44.1 ± 0.24 44.7 ± 0.21	1.69 ± 0.05 2.06 ± 0.04	2.03 ± 0.06 2.30 ± 0.05
CONTROL MEAN	**397B ± 3.80**	**2.10B ± 0.06**	**44.4 ± 0.16**	**1.88 ± 0.04**	**2.17 ± 0.04**
Exp 1 Test Exp 2 Test	408 ± 5.98 413 ± 5.66	2.38 ± 0.07 2.36 ± 0.08	43.0 ± 0.30 45.7 ± 0.24	1.75 ± 0.07 2.12 ± 0.05	2.01 ± 0.07 2.37 ± 0.04
TEST MEAN	**410A ± 4.00**	**2.37A ± 0.06**	**44.3 ± 0.24**	**1.93 ± 0.05**	**2.19 ± 0.04**
P=	0.02	0.001	0.68	0.41	0.75

A,B means with different superscripts differ (P<0.05)

Growth rate over the first two weeks was significantly greater in the test profile incubated chicks in both experiments but weights after this age were similar (Table 3).

Table 3. Growth rates

Incubator group	Mean body weights (g ± SE)					
	Day 7	**Day 14**	**Day 21**	**Day 28**	**Day 35**	**Day 42**
Exp 1 Control	128 ± 1.91	381 ± 3.97	818 ± 10.1	1398 ± 14.4	2084 ± 9.4	2665 ± 38.4
Exp 2 Control	162 ± 1.09	393 ± 3.24	834 ± 9.7	1408 ± 20.3	2057 ± 25.8	2636 ± 40.9
CONTROL MEAN	**145B ± 6.52**	**386B ± 3.34**	**825 ± 20.1**	**1403 ± 11.7**	**2071 ± 13.6**	**2650 ± 26.6**
Exp 1 Test	138 ± 4.50	400 ± 10.9	812 ± 13.2	1363 ± 35.2	2113 ± 27.8	2703 ± 26.9
Exp 2 Test	172 ± 2.19	413 ± 13.8	863 ± 15.8	1441 ± 43.7	2094 ± 27.7	2676 ± 38.6
TEST MEAN	**155A ± 7.00**	**407A ± 6.5**	**837 ± 13.7**	**1402 ± 24.2**	**2104 ± 18.5**	**2690 ± 22.3**
P=	<0.001	0.04	0.05	0.21	0.45	0.64

A,B means with different superscripts differ (P<0.05)

Survival Analysis for the Latency to Lie test results show that birds from the test incubator groups had significantly shorter LTL time (median 94 seconds compared to 136.5 seconds for the control group, P=0.0002, Gehan's Wilcoxon test) and had fewer birds that managed to remain standing for the full five

minutes.

Discussion and Conclusions

Although different, the intended temperature profiles used in both incubators fell within acceptable limits for successful incubation (37.1 to 38.2°C; Hill, 2010) Relative humidity was much harder to control with the incubators used. The incubators used in this preliminary work were semi-commercial types, not machines designed to provide fine control necessary for experimental work. Although the incubators did not perform completely as intended, particularly the control machine, significant differences between the chicks from each incubator profile were observed in chick bone ash and serum calcium at hatch and at growth rate to two weeks of age, and this was relatively consistent. The overall higher incubation temperature in the test treatments appears to have increased moisture loss from fertile eggs as well as embryonic growth, with commensurate impacts on bone ash and serum calcium. High early growth rate has been implicated as contributing to leg weakness problems for some time (Bradshaw et al., 2002; Brickett et al., 2007; Knowles et al., 2008) and the overall increased early growth seen associated with the test incubation profile here may have had its effect on LTL when the birds were older. The two experiments show that bone characteristics, serum calcium levels, early growth rate and later leg weakness could be affected by incubation programmes within the usually acceptable hatchery range.

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References

Berg, C. and Sanotra, G.S. 2003. Animal Welfare, 12:655-659. Bradshaw, R.H., Kirkden, R.D. and Broom, D.M. 2002. Avian and Poultry Biology Reviews, 13(2) May:45-103. Brickett, K.E., Dahiya, J.P., Classen, H.L., Annett, C.B. and Gomis, S. 2007. Poultry Science 86:2117-2125. Buijs, S., Keeling, L., Rettenbacher, S., Van Pouke, E. and Tuyttens, F.A.M. 2009. Poultry Science 88:1536-1543. Buijs, S., Keeling, L.J, Vangestel, C., Baert, J., Vangetye, J., Andre, F. and Tuyttens, M. 2010. Applied Animal Behaviour Science, 124(3-4):97-103. Butterworth, A., Reeves, N.A., Knowles, T.G. and Kestin, S.C. 2003. Animal Welfare. 12(4):661-667(7) Cooper, M. and Wrathall, J. 2010. Animal Welfare 19(S):51-56. Crespo, R. and Shivaprasad, H.L. 2008. In: Diseases of Poultry, 12th Ed. Saif, Y.M. Ed. Blackwell Publishing, Ames, Iowa. 1160-1162. Dawkins, M.S. et al., 2004. Nature 427:342-344. Elfick, D. 2010. Proceedings of the New Zealand Poultry Industry Conference 10:52-63. Genin, O., Hasdai, A., Yalcin, S. and Pines, M. 2008. Proceedings of the World's Poultry Congress, Brisbane, Australia 258 Hardiman, J. 2010. Proceedings AVPA meeting, Christchurch, New Zealand. October 14-15. Hepworth, 2010. Avian Pathology 39(5) Oct:405-409. Hill, D. 2010. Proceedings AVPA Scientific meeting, Gold Coast, Queesland, Australia. Kestin, S.C., Knowles, T.G., Tinch, A.E and Gregory, N.G. 1992. Vet Record, 131:190-194. Knowles, T.G, Kestin, S.C., Haslam, S.M., Brown, S.N., Green, L.E., Butterworth, A., Pope, S.J., Pfeiffer, D and Nicol, C.J. 2008. PLoS ONE, 3(2):e1545.

doi:10.1371/journal.pone.0001545 Oviedo-Rondon, E.O., Wineland, M.J., Christensen, V.L., Brake, J., Small, J. and Cutchin, H. 2008. Proceedings of the World's Poultry Congress, Brisbane, Australia 258. Oviedo-Rondon, E.O., Halpar, J., Wineland, M.J., Ferket, P., Cummock, J. and Kusovschi, A. 2010. Proceedings AAAP meeting, Atlanta, August 1-4. Petek, M., Cibik, R., Yildiz, H, Sonat, F. A., Gezen, S.S., Orman, A. and Aydin, C. 2010. Veterinarija Zootechnika (Vet Med Zoot) T. 51(73). Sherlock, L., Demmers, T.G.M, Goodship, A.E., McCarthy, I.D. and Wathes, C.M. 2010. British Poultry Science 51(1):22-30. Thorp, B.H. 2008. In: Poultry Diseases, 6th Ed. Elsevier. 470-482 Weeks, C.A., Knowles, T.G., Gordon, R.G., Kerr, A.E., Peyton, S.T. and Tilbrook, N.T. 2002. Vet Record, 151:762-764.

Turkey Feathers and Productivity

Source: World Poultry, Vol. 27, No. 6 //24 Aug 2011
By Hybrid Turkeys, Kitchener, ON, Canada

Birds are unique in nature for many reasons but especially for their feathers. Feathers serve multiple functions including protection, warmth, display, and the ability to fly. Logically, a well feathered turkey will be a productive bird.

Feathers are replaced several times during a bird's life and follow consistent, predictable patterns. Since certain nutrients are required for feather growth and replacement, the quality of feathers and their rate of growth can be affected by factors such as nutrient intake, body composition, day length, age and sexual maturity. Highlighted here are feathers in the domestic turkey and how monitoring their status may be used as a management tool for welfare and production.

Feather growth

Historically, feathers have been categorised into six different classes: contour; down; semi-plume; filo-plume; bristle, and powder-down. Contour feathers are the vaned feathers that cover the bird's body. The largest of the contour feathers are the flight feathers that extend beyond the body (wings and tail) and function in flight (Welty, 1975).

Feathers are attached to the bird's skin in the dermal and epidermal layers. All feathers are anchored within a feather follicle that appears (in the turkey embryo) around Day 10 of incubation. All follicles develop during incubation and serve the bird for life. Feathers appear on Day 11 of incubation and contain keratin that is distinct for feathers, scales, beaks and claws. A typical feather grows until it reaches a definite size, then it stops and the cells in the feather follicle become dormant until the feather is molted. Normally, at the proper time for molting, reactivated cells in the follicle grow a new feather that pushes out the old feather above it. Consequently, feathers grow from the base, not the tip. If a feather is accidentally removed, the germ cells in the follicle can reactivate to replace it.

Feather replacement

Feathers grow at different rates, depending upon the species, the bird's age, its diet and health. Other factors in the rate of feather growth include the part of the body where the feather is located, time of year and day length (night-time growth

is slowest). For birds that nest on the ground, including turkeys with precocial young (parents bring no food), feather growth is the most rapid and the soonest completed.

In most birds, feathers are distributed in scattered patches on the body, called “feather tracts”. Within a tract, feathers are arranged in definite patterns, often in rows. Though species vary, most birds have eight different feather tracts. The wing and tail tracts carry the contour feathers responsible for flight. The largest and most distal feathers are clustered together on the wing flipper (hand) and are called the primary wing feathers. Most turkeys have 10 primaries and they have been assigned the Roman Numerals one to ten (I-X) from innermost to the wing tip. The secondary wing feathers are large quill feathers along the forearm (ulna). They vary in number by species. Turkeys normally have 18 and (numbered 1-18) from the wrist to the elbow.

Molting of feathers

As feathers become worn, they loosen in their follicles and drop out, pushed out by the already growing new feather underneath. The prime function of a molt is the replacement of worn feathers. Adult birds normally molt and renew their feathers once a year, usually after the natural breeding season. In young birds plumage is regularly replaced as they reach adult size.

The natural functions of feathers, protection and flight, are indispensible. Therefore, the replacement of feathers is arranged in such a pattern to preserve both functions. The energy demand of feather growth is heavy and usually does not occur during times of reproduction (or in wild birds, during migration). Feathers are not replaced all at once, but with a definite, bilaterally symmetrical pattern. The most common molting pattern of a primary wing feather molt is called “descending” in which feathers drop out beginning with number one (I) at the wrist joint, proceeding in sequence outward and is complete when the 10th (X) feather is replaced.

Productive turkeys have a full feather pack

Birds are unique in nature for many reasons but especially for their feathers. Feathers serve multiple functions including protection, warmth, display, and the ability to fly. Logically, a well feathered turkey will be a productive bird.

The first secondary feathers to molt are those at the two ends of the arm (the wrist and the shoulder, 1 and 18) and the last to be replaced are in the centre of the forearm. Tail feathers molt centrifugally, or from the center outward.

The time interval between the loss of a feather and the complete growth of its replacement varies according to species, body condition, and environmental conditions. Primaries of the domestic chicken require 70-90 days for complete replacement. Poults hatch with natal down, which is replaced by juvenile plumage, followed by adult plumage.

Slow and fast growing

Individual hens of two different lines, Slow-Growing Line (SL) and Fast-Growing Line (FL), were observed in a study. Hens of each line were wing-tagged and housed in the same barn with their hatch mates, but restricted by fencing to one section of the barn to facilitate observations. Photos were taken weekly of the left wing on each hen to document primary wing feather replacement during rearing and conditioning. The left wing of each hen was extended to visually inspect the individual primary wing feathers and the hen's identifying tag. Observations in this study confirm that the 1st primary feather is replaced during the 5th week of age under current conditions. Only two hens in this study replaced the 10th primary, one at Week 20 and the other at Week 28.

Indications

The most recent descriptions of feather development and molting are now decades old. Most research about turkey feathering was conducted with Broad Breasted Bronze turkeys and later comparisons were reported for the Beltsville White. Since that time, feather growth and replacement have not changed much with regard to anatomy and physiology.

Similarly, selection for improved market traits in domestic birds has not changed the feather patterns or feather structure. But modern production practices, for example, may have an impact upon the rate at which feathers are replaced. While the time to completely replace a feather in wild birds can take between 30-45 days, domestic fowl in 1950 required up to 90 days for full replacement. Egg production lines in this study replaced primaries 1 through 5 in less than 49 days while hens of the faster growing lines replaced feathers in 28 days or less while exposed to 12 hours of light per day.

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Restricting hens to only six hours of daylight per day in this study extended the time required to fully replace a feather to between 50 and 70 days. This supports previous reports that feather growth slows during the dark period each day. Early research indicates that the thyroid gland is involved with feather growth which would involve both metabolic rate and thermoregulation by the thyroid and exert an influence upon feather growth.

Effectiveness of management

Nutrition and nutrient absorption also demonstrate an effect upon feather quality in the literature. The presence of weak bands (stress bars) in the development of feathers may indicate enteric disturbances or a lack of essential nutrients for a period of hours during feather growth.

And finally, symmetry in feather replacement is expected. While inspecting the progress of feather replacement, the 5th primary on both wings should be replaced simultaneously. If asymmetry is reported, ensure that lighting intensity, spectrum and day length are each consistent, so that birds perceive photoperiod cues accurately.

Hens within each flock of turkeys always demonstrate variability in body weight, health status and sexual maturity. Feather growth is no exception. Feathering may vary between flocks and between seasons for every company and geographic location. Patterning the feather growth in hens may add another husbandry tool with which to compare the effectiveness of the management programme and may help improve the productivity of flocks conditioned for egg production.

Hen welfare, egg safety consequences of outdoor access

USDA—APHIS, (11/21/2011)
By Dr. Peter Holt

A set of proposed animal welfare guidelines for organic farm animal husbandry was published Oct. 14, by the USDA/AMS National Organic Standards Board (NOSB) Livestock Committee (64). In the poultry section of this document is the requirement that “Outdoor access must be provided to all poultry with the following exceptions:

· Pullets younger than 12 weeks of age;
· Broiler chickens younger than 4 weeks of age;
· Outdoor temperatures below 50oF, and
· Other inclement weather such as heavy snow, sleet, rain, wind or extreme heat that would endanger the health or welfare of the animals.”

Outdoor access for hens is perceived to offer an improved quality of life for the animal as it allows the bird to express her full repertoire of behaviors. However, a search of the literature indicates that outdoor access, also known as free range or pasturing, can have significant negative effects on hen welfare and on the safety of the eggs produced by these individuals.

The following white paper provides the results of this investigation and calls into serious question the advisability of a free range requirement.

Hen welfare
Mortality: Any discussion of welfare necessitates the inclusion of mortality data for that particular housing system. First, the livability of a flock is a good indicator of the health and well-being of the birds and poor livability suggests bird health problems. Second, because the animal generally suffers during the time leading up to death, they are experiencing a poor quality of life and therefore poor

welfare status during this period. Increased mortality stems from multiple causes such as disease, bird aggression, suffocation, and predators (34; 35). The number of studies comparing pasturing versus enclosed housing for laying hens is not large but the evidence for a problem is mounting.

A study published by Sherwin et al. in 2010 (52) found that mortality was higher in barn housing compared with free range. Conversely, Hane et al. (25) found significantly higher mortality in Swiss hens allowed outdoor access compared with confined hens. Similarly, hen deaths in Danish organic (free range) flocks ranged from 2% to 91% with a mean of 20.8% compared with 7% for confined flocks (60). Elson (14) noted a cumulative mean mortality in the U.K. of 14% in pastured flocks compared with 4.5% and 6% in aviary- and barn-raised hens, respectively.

Infectious disease

Disease also constitutes an important component of welfare as the health, or lack of, of the bird will impact the survivability and productivity of that individual. With the transition of laying hens from cages to floor and free-range environments, diseases not seen in laying hens for decades are now re-emerging in increasing numbers. Histomoniasis, commonly known as blackhead, is a systemic disease affecting multiple organ systems but primarily the liver and large intestine. The disease is caused by the protozoan Histomonas meleagridis and is associated with consumption of the parasite from the soil or from intermediate carriers such as the nematode Heterakis gallinae or from earthworms (17). Histomoniasis is therefore extremely difficult to eradicate once it has become established. An outbreak of histomoniasis in a Belgium free-range layer flock caused 6% mortality and 11% decreased egg production (17). Stokholm et al (60) reported blackhead in 6 of 15 Danish organic flocks studied compared with no H. meleagridis isolations from the deep litter confined flocks.

A second resurgent disease, Erysipelas, has long been a turkey disease problem and is now observed more frequently in laying flocks. The disease is caused by the soil-borne bacterium Erysipelothrix rhusiopathiae and is a systemic infection in poultry leading, in many cases, to death as well as a significant decrease in egg production (16). Erysipelas is most prevalent in outdoor flocks, although it can be found in confined flocks as well. In a Swedish study, outbreaks of erysipelas occurred in 7.8% of flocks raised in indoor litter-based houses and 26% of free-range systems (21) while in a Danish report, erysipelas was detected only in organic (free-range) flocks (60).

An uptick in parasitic infections has also been observed as fecal worm eggs and coccidial oocytes were more frequently found in droppings from pastured versus confined birds (25; 46). These organisms can also reside in intermediate hosts such as grasshoppers, earthworms and beetles (73), which are part of the diet of birds, particularly free range, and increases the difficulty of eliminating the parasites from the environment. Parasitic infections can affect chicken feed

efficiencies; modify the course of other diseases (13; 47; 52) or act as a vector for disease organisms such as Salmonella (5) and Histomonas (17).

Perhaps the most disturbing aspect of a particular parasitic infection is the ability of the nematode Ascaridii galli to enter table eggs during egg development (48), resulting in live intact roundworms in the egg contents and an unpleasant surprise for the consumer. The worms should be found during the candling portion of egg processing but such discovery is dependent upon the efficiency and competence of the operation.

Other, more common, disease organisms also occur more frequently in free-range flocks. Colibacillosis, a systemic disease produced by the bacterium Escherichia coli, causes significant losses to the poultry industry worldwide. This disease exerts its most serious effects in layer flocks when they are in peak lay and infections can result in significant mortalities (66). The incidence of systemic colibacillosis was substantially higher in Danish organic versus confined flocks (60) and Kaufmann-Bart and Hoop (29) noted that “the increase in colibacillosis in Switzerland was a result of the introduction of free-range management in laying flocks in 1998.” Fossum et al. (21) found that E. coli infections tended to be higher in litter-based systems, including free-range birds, but did not distinguish between confined and free-range systems.

Pasteurella multocida is a bacterial pathogen causing fowl cholera, a systemic and potentially devastating disease in poultry (22). This organism can infect both mammalian and avian species and therefore increases the difficulty of preventing introduction of the organism into flocks, especially in those allowed outdoors. Genetic characterization of fowl cholera strains isolated from waterfowl in Denmark showed them to be very closely related to strains infecting Danish free-range flocks (7). In a study by Stokholm et al. (60), three of 15 Danish organic flocks were infected with P. multocida compared with none of the confined flocks. Two of the organic flocks posted mortalities of 62% and 91% of which P. multocida was the cause of death in 46.1% and 22% of the cases, respectively. Christensen et al. (8) demonstrated that approximately 80% of fowl cholera in Danish poultry was found in flocks having outdoor access. While not all studies demonstrate fowl cholera problems in free-range birds (21), the above studies demonstrate the potential for catastrophic infections in birds allowed access to the outdoors.

Avian influenza virus (AIV) continues to cause problems in the poultry industry worldwide. The highly pathogenic avian influenza (HPAI) causes fowl plague, a devastating infection in avian species resulting in high morbidity and mortalities up to 100%. An estimated 250 million birds either died or were euthanized due to HPAI worldwide (43; 62). The last major HPAI outbreak in the U.S. occurred in 1983-1984 which resulted in the loss of 17 million birds. Originally only infecting avian species, HPAI was observed to change in 1997 when humans became sick and died from infection by these viruses, becoming a serious human health

threat in addition to being a significant poultry industry problem (55). Influenza viruses infect hosts via hemagglutinins (HA), proteins which attach to and initiate invasion of cells within the body of the host. There are 16 subtypes of this protein labeled H1-H16 (62) and fowl plague viruses possess either the H5 or H7 hemagglutinin. However, not all H5 or H7 AIV produce fowl plague and these are termed low pathogenic avian influenza (LPAI). These viruses produce mild to moderate morbidity but they can mutate to become HPAI (62) so identification of any flocks infected with H5 or H7 LPAI generally means the eradication of those birds.

Many of the AIV possessing hemagglutinin types other than H5 or H7 also infect poultry and are considered LPAI, producing symptoms ranging from undetectable to moderate morbidity although, when combined with other infections such as E. coli, mortality may be significant (24). Sources of these viruses are generally feral birds, in particular waterfowl (4) and these have been implicated in serious outbreaks of LPAI in multiple states (24), especially in turkeys. Turkeys were originally raised free range which allowed significant interaction between those birds and waterfowl. However, “After the 1997 outbreak of HPAI H5N1 in Hong Kong, with resulting human infection, the Minnesota industry collectively decided to cease growing turkeys on the range. Today, less than 0.5% of Minnesota turkey flocks are range reared, and introductions of AI into turkey populations have declined from an average of more than five per year to less than one.” (24). Similarly, Terregino et al. (63) found that backyard free-range farming in Italy was at high risk for the introduction of AIV from waterfowl. Eliminating outdoor access dramatically decreased the incidence of AIV in the flocks and therefore improved the health and well-being of those birds. Conversely, requiring outdoor access for organic laying hens will increase the incidence of AIV in these flocks and decrease their health and wellbeing.

Noninfectious problems: Problems need not be infectious in nature as cannibalism, piling, foot troubles and predation also present their own welfare issues. Cannibalism and feather pecking pose significant problems for commercial poultry and can be the most prevalent noninfectious cause of hen mortality. Stokholm et al. (60) found that, among dead hens submitted to the laboratory for examination, the prevalence of mortality due to cannibalism ranged from 0.8%-36.1%. These problems were observed in all housing systems and, in some cases, little difference could be observed between free range and confined systems (25; 53; 60) while other studies have shown difficulties. Swarbrick (61) noted that cannibalism and feather pecking was a severe problem in several free-range flocks studied in the U.K. and Fossum et al. (21) found that cannibalism was the main cause of mortality in 17.4% of Swedish free-range flocks compared with 3.9% of confined flocks.

Piling, also known as smothering or clumping, occurs when birds mass together in response to different stimuli with a resultant loss of animals due to suffocation. Mortality can be substantial. Bright and Johnson (3) reported that smothering

was responsible for 40% of the mortalities in 4 of 10 free-range laying flocks. Stokholm et al. (60) noted that piling resulted in 7% and 8% mortality in two Danish organic flocks and 1-2% in 5 other organic flocks compared with 0.8% or less observed in confined flocks.

Foot health is another parameter that will affect hen wellbeing as foot pain increases bird suffering and lameness impacts the ability of the bird to reach feed and water. Some studies have shown minimal difference between housing systems (35; 36) while Elson (14) noted foot problems in 14.8% of confined flocks compared with 32.8% or higher in birds raised free range and Shimmura et al. in Japan (54) found significantly greater foot damage in birds raised free range compared with confined individuals.

Allowing hen access to the outdoors also provides predators access to the hen. Predation is essentially a part of the free range experience with which producers, and especially the hens, must contend. Stokholm et al. (60) reported mortality due to predation ranged from 0-3.7% in Danish organic flocks while indoor flocks experienced no mortality from predators. Losses due to predation in the U.K. and Switzerland amounted to 1.97% (41) and 1.4% (29), respectively. Providing hens free range access allows them to express more varied behaviors with the concomitant welfare benefits. However, these benefits come at too high of a cost, both from an economic and a welfare standpoint.

The “Five Freedoms”, developed in the 1970s and 1980s by the Farm Animal Welfare Council in the U.K., were a set of guidelines for the care and welfare of livestock (18). These freedoms provided the standards for judging how well a particular husbandry system met the welfare needs for the animals kept within it. Free range access for hens has generally been considered the ultimate in animal welfare and should excel in all Five Freedoms. Does it?

Pasturing certainly should meet the First Freedom, from hunger and thirst, as these are standard husbandry criteria which should be met by all housing systems. Similarly, the Second Freedom, from thermal and physical discomfort, should be met by all systems in that they provide adequate shelter from inclement weather conditions. Free range may provide the hen even a little more freedom, allowing her to move to a more comfortable resting spot.

For the Third Freedom, from pain, injury, and disease, pasturing fairs rather poorly. Hens allowed outdoors exhibit higher mortality (14; 25; 60), and a greater and more varied incidence of disease (8; 17; 21; 46; 60). Mortality and disease are two strong indicators that flock well-being is diminished under free-range conditions. Further, increased feather pecking and cannibalism were also found in some studies (21; 61) as were foot problems (14; 54) and piling/smothering (3; 60).

Free range fairs very well in the Fourth Freedom, to express normal behavior, in

that it allows hen access to the outdoors in the sunshine and fresh air to forage in the dirt for insects and grubs and to dust bathe. However, many of these behaviors can also be expressed indoors with space provided for dust baths, materials on the ground for the hens to peck and forage through, and a screened porch for hen access to sunshine and fresh air. Further, chickens exhibit a natural fear of wide open spaces which results in only a small percentage of a flock that has its needs met indoors to actually venture outside (12; 57). The perceived benefits of free range would only apply to this portion of the flock.

Finally, the Fifth Freedom, from fear and distress, is also questionable in a free-range situation. Again, feather pecking and cannibalism can be a significant problem in this system and present an extremely distressful situation for the chickens involved. Predators are essentially only a free-range problem and can exact a significant toll on the flock (29; 41; 60). Besides the physical loss of productive animals, each predator attack will not only be distressful for the individual hen involved but for the flock at large, resulting in “panic smothers” where hens pile up, and ultimately suffocate, to escape from the threat (3). Therefore, the superiority of free range over confined housing is questionable as it exhibits significant flaws regarding the welfare of the birds allowed outdoors. As Elson (14) summed it up well in 2008, “Allowing poultry outside access increases their freedom and behavioural repertoire but is accompanied by greater risks to important aspects of their well-being. The term “welfare-friendly” must take all these factors into account.” The current proposal to mandate free-range hen management as a requirement for the organic egg designation is based much more on welfare perception rather than on actual welfare scientific facts.

Egg safety

Salmonella contamination: Salmonella enterica serovar enteritidis (S. enteritidis) surprised egg producers, health care workers and infectious disease experts in the 1980s after the discovery of the organism inside intact table eggs, posing a significant new foodborne threat for the consuming public (59). Subsequent research showed that, following infection of the hen through consumption of the organism, S. enteritidis invaded the hen reproductive tract and gained entry into the egg in utero prior to shell formation (30; 45) or through shell pores during transit of the egg down the oviduct into the cloaca (39). Significant effort has been expended to reduce the incidence of S. enteritidis on the farm and subsequently in the consuming population. The effort has been largely successful in that the incidence of human S. enteritidis infections has decreased dramatically in the U.S. (1). However, the one-half billion egg recall and more than 2,000 illnesses due to S. enteritidis in the summer of 2010 brought into sharp focus that S. enteritidis egg contamination was still a significant threat and diligence by the producer, processor, retailer and consumer was crucial to prevent future such outbreaks.

The Food & Drug Administration published document 21 CFR Parts 16 and 118 “Prevention of Salmonella enteritidis in shell eggs during production, storage, and

transportation; Final Rule" (19), also known as the Egg Rule, which outlined procedures to prevent on-farm infection of hens with S. enteritidis, and the potential production of contaminated eggs, coupled with the proper treatment of eggs after lay. One stipulation of the Egg Rule is to "prevent stray poultry, wild birds, cats and other animals from entering poultry houses." Wildlife has been shown to be ample carriers of Salmonella organisms. Rodents (11; 27; 32), birds (9; 10; 11), foxes (11), skunks (32), opossums (32), cats (32) and insects (11; 23; 40; 72) have all been shown to harbor Salmonella. Indeed, Wales et al. (72) found that the prevalence of Salmonella-positive samples from wildlife vectors at or near poultry houses was double that of positive samples from the houses. Reducing interaction of hens with wildlife is critical to preventing infection of hens with Salmonella, and is, in fact, mandated by FDA for inside the house. By allowing hen access to the outdoors, the biosecurity of a facility is compromised as hens can freely interact with wildlife vectors currently residing in the area. Further, by providing exit sites to allow hen outdoor access, the biosecurity of the building is again compromised, allowing entry of birds, insects, rodents and other wildlife into the house.

The bulk of the studies examining Salmonella recovery from free range versus confined facilities were conducted in the EU and most found little difference between facility types. Mahe et al. (38) and Snow et al. (55) recovered Salmonella in 11.5% and 7.69% of barn facilities compared with 8.55% and 6.29% free range in France and the U.K., respectively. Van Hoorebeke et al. (68) reported similar results in a cumulative study of farms in Belgium, Germany, Italy and Greece. Mollenhorst et al. (42) reported an increased incidence of Salmonella in Dutch flocks provided an outdoor run but this was only observed in farms with same age flocks. A similar risk was not observed in farms containing different aged flocks. The movement from caged, confined housing to free range is a fairly recent situation, however, and the facilities are therefore new. Van Hoorebeke et al. (67) found that facility age increases the incidence of Salmonella contamination and as the number of flocks raised free range on a site increases over time, with the subsequent buildup of Salmonella in the soil, wildlife and buildings (11), the free range Salmonella incidence may change. Because of the limited number of free-range flocks in the U.S., a paucity of studies exist which examine Salmonella incidence in confined versus free-range flocks. However, Kinde and colleagues in 1996 (32) reported an outbreak of S. enteritidis on an egg farm in California. No S. enteritidis was recovered from any birds or eggs in two of the three barn-type houses and, in the third house, the organism was recovered from 1.67% (1/60) of birds examined and egg contamination was 2.03/10,000 eggs. Isolation of S. enteritidis from free-range birds was 1.67% (1/60) in one house and 50% (30/60) in the second. Egg contamination was 14.87/10,000 eggs in the first house and 19.06/10,000 eggs in the second, an extremely dangerous food safety situation. The ultimate source of contamination was found to be a stream that flowed past the farm (33). While all houses were equally exposed to the stream, the S. enteritidis problem was primarily found only in the free-range hens, bringing into sharp focus the inherent

risks imposed upon hens allowed access to the outdoors.

Chemical contamination: Polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs) are man-made chemicals toxic to humans and other animal species and are considered one of the most toxic substances in the human food chain (49). Human exposure to these compounds results in a wide range of health problems including cancer, immune deficiencies, reproductive and developmental abnormalities, central and peripheral nervous system pathologies, and endocrine disruption, including diabetes and thyroid disorders (44; 49).

PCDDs and PCDFs, often referred to simply as “dioxins”, are produced as unwanted byproducts in many manufacturing processes (49) and during incineration activities including municipal waste incinerators and backyard trash burning (28; 37). PCBs are industrial chemicals manufactured in high volume prior to 1980. Both classes of chemicals are widespread and persistent contaminants in the environment (50; 65). Environmental levels tend to be highest in and near urban industrialized regions (28) but winds and rains disperse the chemicals long distances (15). Farming areas may exhibit significant soil contamination originating from air pollution (6; 28) and improper/illegal dumping of dioxin- and PCB-containing wastes (15; 71).

Hens consuming soil contaminated with these highly lipophilic (fat-loving, will dissolve into fat-containing tissues) chemicals will bioaccumulate the compounds in their bodies, including the egg (58). As a consequence, hens allowed to forage on dioxin- or PCB-contaminated ranges readily accumulate the contaminants into their eggs. Chang et al. (6) showed that eggs from free-range hens in Northern California raised 1.5-4.5 km from the site of a pentachlorophenol wood treatment plant fire had dioxin levels up to 100 times that of eggs from hens raised indoors. Even low levels of the chemical in the soil could result in significant egg contamination if the hens were allowed to forage over wide ranges (26). Schuler et al. (51) found that eggs from free-range hens in Switzerland possessed high levels of dioxins in their contents and the egg concentrations correlated with levels found in the soils used for foraging. Kijlstra et al. (31) did not find such a correlation in the Netherlands but did find that restricting the amount of time hens were allowed to forage outdoors reduced the levels of egg dioxin and PCB contamination. In an EU survey, eggs from free-range hens exhibited higher dioxin and PCB levels than those from indoor hens and 10% of the eggs exceeded the EU maximum residue limit (MRL) in eggs of 3 pg dioxin toxic equivalency (TEQ)/g of lipid (49). Eggs exceeding the MRL are banned from being sold and must be destroyed. Dioxin and PCB contamination was highest in eggs from free-range hens near urban industrial areas but could also be found in free-range eggs on rural farms (50). A recent study in Taiwan (28) showed extensive dioxin contamination of eggs from free-range hens which was 5.7 times higher than eggs from similar hens raised indoors. Like the EU study, a portion of these eggs exceeded the EU MRL and the highest egg contamination

occurred in eggs from hens located on farms near urban industrial areas while lower, although significant, levels could also be found in free-range eggs from rural settings.

While farmland contamination of dioxins and PCBs pose the most serious threat to the safety of eggs from free-range hens, other potential chemical risks also exist. Bioaccumulation into eggs of heavy metals such as lead and mercury and pesticides such as DDT has also been reported in the EU (69). In Brazil, Vieira et al. (70) found high levels of DDT in eggs from free-range hens compared with those from hens raised indoors, even though DDT application had ceased in the area for the past 10 years, indicating the persistence of this chemical in the environment. In the U.K., a food safety alert/recall was issued for organic eggs from the company Waitrose Ltd., a result of lead shot consumption by the free-range foraging hens (20).

The above information indicates that environmental chemical contamination poses a real threat to the safety and integrity of free-range eggs. In the Netherlands and Belgium, if eggs from a farm exceed the EU dioxin limits, that farm is out of business until the problem is rectified (Dr. Aize Kiljstra, Wageningen University, Netherlands and Dr. Luc Pussemier, Coda-Cerva Veterinary Research Center, Brussels, Belgium, respectively, personal communications), which may take some time. Little is currently known about the potential magnitude and breadth of chemical contamination of U.S. farmlands. Mandating free-range husbandry for an organic egg designation is ill advised and imposes an unnecessary risk to the consumer as well as an undue burden upon the producer. Raising hens inside eliminates hen consumption of toxic agents present in the environment and should be retained as a viable method for producing the healthy, nutritious organic egg that consumers expect. Free-range husbandry should be an optional alternative, providing suitable testing is performed to ensure the safety of the eggs being produced.

Summary

The proposed recommendation by the NOSB that hens must have soil-based outdoor access as one of the requirements for their eggs to receive the organic certification is based on the premise that the more freedom the birds experience, the better their welfare will be. It is fortunate that this premise can be tested since the EU adopted a similar mindset in the 1990s and a substantial number of free-range flocks were established across Europe over the past decade. The information gained from these flocks allowed for an in-depth examination of how the hens, and their eggs, fared under this housing situation, which can then be used by the NOSB to make solid decisions based on science rather than perception.

It is difficult to make an argument that allowing hens outdoor access on the soil is more welfare friendly when mortality is generally higher in free-range flocks, the hens suffer a higher disease incidence, including the resurgence of illnesses

rarely seen in layer flocks for 50 years, greater exposure to predators, increased frequency of piling/smothering and occasional higher prevalence of feather pecking and cannibalism. Have the hens fared better? Not really.

What about the eggs? The current literature shows little difference between the incidence of S. enteritidis in pastured versus confined flocks although the scenario described by Kinde and colleagues in 1996 demonstrated the dangers intrinsic to free-range hen exposure to the environment. The inherent biosecurity lapse in houses possessing multiple openings in the sides of the house for hen egress and entry, coupled with the ready interaction of free-range hens with potential wildlife Salmonella vectors, make such a housing situation difficult to meet the criteria outlined in the FDA Final Egg Rule.

However, the most serious problem is the contamination of eggs with dioxins/PCBs by foraging free-range hens ingesting contaminated soil. These eggs put the consuming public at risk for a variety of chronic diseases, including cancer. The incidence of such contamination has been extremely problematic in EU free-range eggs and each country is working hard to address this situation, generally by closing the farm until the problem is remediated. Dioxin/PCB contamination of U.S. farmlands is virtually unknown as is the consequence of pasturing hens on this soil. However, considering the agricultural and industrial similarities in the US and EU, it is doubtful that contamination will differ significantly. It is hoped that the U.S. will learn from the EU experience and act in a manner to avoid similar problems.

About the Author:
Peter S. Holt received his PhD in Microbiology/Immunology in 1985 from the Department of Microbiology at the University of Missouri School of Medicine. Prior to his retirement in July, 2011, he spent the past 24 years working as an immunologist for the USDA Agricultural Research Service in Athens, Ga., examining the effect of stress on the immune system of chickens. His primary research focus was studying the impact of induced molting of laying hens via feed withdrawal on immunity and susceptibility to disease. His work showed that this procedure, which, at the time, was used by over 70% of the US egg industry to recycle aging hens for a second egg lay, depressed the immune response of these birds and made them susceptible to infections by disease agents such as S. enteritidis. Based on these and subsequent studies in the field, the USDA Food Safety & Inspection Service determined that induced molting by feed withdrawal was a risk factor for production of eggs contaminated with S. enteritidis. Holt's research also examined methods to ameliorate the problem including the development of a diet for inducing a molt in hens, which put the hens into the needed egg laying pause but did not exacerbate S. enteritidis problems. This diet was later tested in a commercial production facility with results similar to or better than feed withdrawal, demonstrating the commercial feasibility of molt diets. Feed withdrawal is no longer considered an acceptable method in the U.S. to molt hens.

For the past three years prior to his retirement, Holt also served as the chair of the Egg Safety & Quality Study Group in the Social Sustainability of Egg Production Project (SSEP). The SSEP is a group of university, government and industry scientists brought together to holistically examine the impact of changing U.S. layer housing from the conventional cages to alternative housing systems on bird welfare, egg safety and quality, the environment, commercial effects and consumer attitudes.

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References

1. Braden, C.R. 2006. Salmonella enterica serotype Enteritidis and eggs: A national epidemic in the United States. Clin. Infect. Dis. 43:512-517.

2. Bray, T.S., and M.B. Lancaster. 1992. The parasitic status of land used by free-range hens. Brit. Poult. Sci. 33: 1119.

3. Bright, A. and E.A. Johnson. 2011. Smothering in commercial free-range laying hens: a preliminary investigation. Vet. Rec. 168:512.

4. Capua, I. and S. Marangon. 2006. Control of avian influenza in poultry. Emerg. Infect. Dis. 12:1319-1324.

5. Chadfield, M, A. Permin, P. Nansen, and M. Bisgaard. 2000. Investigation of the parasitic nematode Ascaridia galli (Shrank 1788) as a potential vector for Salmonella enterica dissemination in poultry. Parasitol. Res. 87:317-325.

6. Chang, R., D. Hayward, L. Goldman, M. Harnly, J. Flattery, and R. Stephens. 1989. Foraging animals as biomonitors for dioxin contamination. Chemosphere 19:481-486.

7. Christensen, J.P., H.H. Dietz, and M. Bisgaard. 1998. Phenotypic and genotypic characters of isolates of Pasteurella multocida obtained from back-yard poultry and from two outbreaks of avian cholera in avifauna in Denmark. Avian Pathol. 27:373-381.

8. Christensen, J.P., K.D. Petersen, H.C. Hansen, and M. Bisgaard. 1999. Forekomst af fjerkraekolera i dansk avifauna og fjerkraeproduktion. Dansk Veterinaertidsskrift. 82:342-346.

9. Cizek, A., I. Literak, K. Hejlicek, F. Treml, and J. Smola. 1994. Salmonella contamination of the environment and its incidence in wild birds. Zantralbl. Veterinarmed B. 41:320-327.

10. Craven, S., N.J. Stern, E. Line, J.S. Bailey, N.A. Cox, and P. Fedorka-Cray. 2000. Determination of the incidence of Salmonella spp., Campylobacter jejuni, and Clostridium perfringens in wild birds near broiler chicken houses by sampling intestinal droppings. Avian Dis.

44:715-720.

11. Davies, R.H. and M. Breslin. 2003. Observations on Salmonella contamination of commercial laying farms before and after cleaning and disinfection. Vet. Rec. 152:283-287.

12. Dawkins, M.S., P.A. Cook, M.J. Whittingham, K.A. Mansell, and A.E. Harper. 2002. What makes free-range broiler chickens range? In situ measurement of habitat preference. Anim. Behav. 66:151-160.

13. Eigaard, N.M., T.W Schou, A. Permin, J.P. Christensen, C.T. Ekstrom, F. Ambrosini, D. Cianci, and M. Bisgaard. 2006. Infection and excretion of Salmonella Enteritidis in two different chicken lines with concurrent Ascaridia galli infection. Avian Pathol. 35:487-493.

14. Elson, A. 2008. Do extensive poultry systems really offer superior welfare? Poultry International – digital. 47(3): 10-14. Available at http://www.poultryinternational-digital.com/poultryinternational/200803/#pg10. Accessed 9/16/2011.

15. Environmental Protection Agency. 2010. Polychlorinated biphenyls (PCBs). Basic Information. Available at http://www.epa.gov/wastes/hazard/tsd/pcbs/pubs/about.htm Accessed August 30, 2011.

16. Eriksson, H., S. Brannstrom, H. Skarin, and J. Chirico. 2010. Characterization of Erysipelothrix rhusiopathiae isolates from laying hens and poultry red mites (Dermanyssus gallinae) from an outbreak of erysipelas. Avian Pathol. 39: 505-509.

17. Esquenet, C., P. De Herdt, H. De Bossere, S. Ronsmans, R. Ducatelle, and J. Van Erum. 2003. An outbreak of histomoniasis in free-range layer hens. Avian Pathol. 32:305-308.

18. Farm Animal Welfare Council. http://www.fawc.org.uk/freedoms.htm

19. Food and Drug Administration. 2009. 21 CFR Parts 16 and 18 Prevention of Salmonella Enteritidis in Shell Eggs During Production, Storage, and Transportation; Final Rule. Available at http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/EggSafety/EggSafetyActionPlan/ucm170746.htm Accessed 9/29/2011.

20. Food Standards Agency, 2008. Waitrose Ltd recalls organic eggs from one farm due to lead contamination. Available at http://www.food.gov.uk/enforcement/alerts/2008/may/waitroseeggs Accessed August 30, 2011.

21. Fossum, O., D.S. Jansson, P.E. Etterline, and I. Vagsholm. 2009. Cause of mortality in laying hens in different systems in 2001-2004. Acta Vet. Scand. 51:3

22. Glisson, J.R., C.L. Hofacre, and J.P. Christensen. 2008. Fowl Cholera. Pages 739-758 in Disease of Poultry. Y.M. Saif, A.M. Fadly, J.R. Glisson, L.R. McDougald, L.K. Nolan, and D.E. Swayne, ed. Blackwell Publishing, Ames, IA.

23. Gray, J. P., C. W. Maddox, P. C. Tobin, J. D. Gummo, and C. W. Pitts. 1999. Reservoir competence of Carcinops pumilio for Salmonella enteritidis (Eubacteriales: Enterobacteriaceae). J. Med. Entomol. 36:888-891.

24. Halvorson, D.A. 2009. Prevention and management of avian influenza outbreaks: experiences from the United States of America. Rev sci. tech. Off. Int. Epiz. 28:359-369.

25. Hane, M., B. Huber-Eicher, and E. Frohlich. 2000. Survey of laying hen husbandry in Switzerland. World's Poult. Sci. J. 56:21-31.

26. Harnly, M.E., M.X. Petreas, J. Flattery, and L.R. Goldman. 2000. Polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran contamination in soil and home-produced chicken eggs near pentachlorophenol sources. Environ. Sci. Technol. 34:1143-1149.

27. Henzler, D. J. and H. M. Opitz. 1992. The role of mice in the epizootiology of Salmonella enteritidis infection on chicken layer farms. Avian Dis. 36:625-631.

28. Hsu, J.-F., C. Chen, and P.-C. Liao. 2010. Elevated PCDD/F levels and distinctive PCDD/F congener profiles in free-range eggs. J. Agric. Food Chem. 58:7708-7714.

29. Kaufmann-Bart, M., and R.K. Hoop. 2009. Diseases in chicks and laying hens during the first 12 years after battery cages were banned. Vet. Rec. 164:203-207.

30. Keller, L.H., C.E. Benson, K. Krotec, and R.J. Eckroade. 1995. Salmonella enteritidis colonization of the reproductive tract and forming and freshly laid eggs of chickens. Infect. Immun. 63:2443-2449.

31. Kijlstra, A., W.A. Traag, and L.A.P. Hoogenboom. 2007. Effect of flock size on dioxin levels in eggs from chickens kept outside. Poult. Sci. 86:2042-2048.

32. Kinde, H., D. H. Read, R. P. Chin, A. A. Bickford, R. L. Walker, A. Ardans, R. E. Breitmeyer, D. Willoughby, H. E. Little, D. Kerr, and I. A. Gardner. 1996a. Salmonella enteritidis, phage type 4 infection in a commercial layer flock in Southern California: bacteriological and epidemiologic findings. Avian Dis. 40:665-671.

33. Kinde, H., D. H. Read, A. Ardans, R. E. Breitmeyer, D. Willoughby, H. E. Little, D. Kerr, R. Gireesh, and K.V. Nagaraja. 1996b. Sewage effluent: Likely source of Salmonella enteritidis, phage type 4 infection in a commercial chicken layer flock in Southern California. Avian Dis. 40:672-676.

34. Knierim, U. 2006. Animal welfare aspects of outdoor runs for laying hens: a review. NJAS 54:133-145.

35. Lay Jr., D.C., R.M. Fulton, P.Y. Hester, D.M. Karcher, J.B. Kjaer, J.A. Mench, B.A. Mullens, R.C. Newberry, D.J. Nicol, N.P. O'Sullivan, and R.E. Porter. 2011. Hen welfare in different housing systems. Poult. Sci. 90:278-294.

36. LayWel. 2006. Welfare implication of changes in production systems for laying hens: Deliverable 7.1. Overall strengths and weakness of each defined housing system for laying hens, and detailing the overall welfare impact of each housing system. http://www.laywel.eu/web/pdf/deliverable%2071%20welfare%20assessment.pdf. Accessed 10/16/2011.

37. Lemieux, P.M., CC. Lutes, J.A. Abbott, and K.M. Aldous. 2000. Emissions of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans from the open burning of household waste in barrels. Environ. Sci. Technol. 34:377-384.

38. Mahé, A., S. Bougeard, A. Huneau-Salaün, S. Le Bouquin, I. Petetin, S. Rouxel, F. Lalande, P.A. Beloeil, and N. Rose. 2008. Bayesian estimation of flock-level sensitivity of detection of Salmonella spp., Enteritidis and Typhimurium according to the sampling procedure in French laying-hen houses. Prev. Vet. Med. 84:11-26.

39. Messens, W., K. Grijspeerdt, and L. Herman. 2005. Eggshell penetration by Salmonella: A review. World's Poult. Sci. J. 61:71-85.

40. Mian, L.S., H. Maag, and J.V. Tacal. 2002. Isolation of Salmonella from muscoid flies

at commercial animal establishments in San Bernardino County, California. J. Vector Ecol. 27:82-85.

41. Moberly, R.L., P.C.L. White, and S. Harris. 2004. Mortality due to fox predation in free-range poultry flocks in Britain. Vet. Rec. 155:48-52.

42. Mollenhorst, H., C. J. van Woudenbergh, E. G. M. Bokkers, and I. J. M. de Boer. 2005. Risk factors for Salmonella enteritidis infections in laying hens. Poult. Sci. 84:1308-1313.

43. Monke, J. and M.L. Corn. 2007. CRS Report for Congress: Avian Influenza in Poultry and Wild Birds. Order Code RL33795. http://www.cnie.org/nle/crsreports/07Feb/RL33795.pdf. Accessed November 3, 2011.

44. National Research Council. 2006. Health Risks from Dioxin and Related Compounds. Evaluation of the EPA Reassessment. The National Academies Press. Washington, DC. pp. 1-173. Available at http://www.ejnet.org/dioxin/nas2006.pdf Accessed August 30, 2011.

45. Okamura, M., Y. Kamijima, T. Miyamoto, H. Tani, K. Sasai, and E. Baba. 2001. Differences among six Salmonella serovars in abilities to colonize reproductive organs and to contaminate eggs in laying hens. Avian dis. 45:61-69.

46. Permin, A., M. Bisgaard, R. Frandsen, M. Pearman, J. Kold, and P. Nansen. 1999. Prevalence of gastrointestinal helminths in different poultry production systems. Brit. Poult. Sci. 40:439-443.

47. Qin, J.R., A. Arakawa, E.Baba, T. Fukata, T. Miyamoto, K. Sasai, and G.S.K. Withanage. 1995. Eimeria tenella infection induces recrudescence of previous Salmonella enteritidis infection in chickens. Poult. Sci. 74:1786-1792.

48. Reid, W.M., J.L. Mabon, and W.C. Harshbarger. 1973. Detection of worm parasites in chicken eggs by candling. Poult. Sci. 52:2316-2324.

49. Schecter, A. L. Birnbaum, J.J. Ryan, and J.D. Constable. 2006. Dioxins: an overview. Environ. Res. 101: 419-428.

50. Schoeters, G. and R. Hoogenboom. 2006. Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. Mol. Nutr. Food Res. 50:908-914.

51. Schuler, F., P. Schmid, and C. Schlatter. 1997. The transfer of polychlorinated dibenzo-p-dioxins and dibenzofurans from soil into eggs of foraging chicken. Chemosphere. 34: 711-718.

52. Shane, S.M., J.E. Gyimah, K.S. Harrington, and T.G. Snider, III. 1985. Etiology and pathogenesis of necrotic enteritis. Vet. Res. Commun. 9: 269-287.

53. Sherwin, C.M., G.J. Richards, and C.J. Nicol. 2010. Comparison of the welfare of layer hens in 4 housing systems in the UK. Brit. Poult. Sci. 51:488-499.

54. Shimmura, T., S. Hirahara, T. Azuma, T. Suzuki, Y. Eguchi, K. Uetake, and T. Tanaka. 2010. Multi-factorial investigation of various housing systems for laying hens. Br. Poult. Sci. 51:31-42.

55. Sims, L.D., T.M. Ellis, K.K. Liu, K. Dyrting, H. Wong, M. Peiris, Y. Guan, and K.E. Shortridge. 2003. Avian influenza in Hong Kong 1997-2002. Avian Dis. 47:832-838.

56. Snow, L. C., R. H. Davies, K. H. Christiansen, J. J. Carrique-Mas, A. J. C. Cook, and

S. J. Evans. 2010. Investigation of risk factors for Salmonella on commercial egg-laying farms in Great Britain 2004-2005. Vet. Rec. 163:649-654.

57. Sossidou, e.N., a. Dal Bosco, H.A. Elson, and C.M.G.A. Fontes. 2011. Pasture-based systems for poultry production: implications and perspectives. World's Poult. Sci. J. 67: 47-58.

58. Stephens, R.D., M.X. Petreas, and D.G. Hayward. Biotransfer and bioaccumulation of dioxins and furans from soil: Chickens as a model for foraging animals. Sci. Total Environ. 175: 253-273.

59. St. Louis, M.E., D.L. Morse, M.E. Potter, T.M. DeMelfi, J.J. Guzewich, R.V. Tauxe, and P.A. Blake. 1988. The emergence of Grade A eggs as a major source of Salmonella enteritidis infections: new implications for the control of salmonellosis. JAMA. 259:2103-2107.

60. Stokholm, N.M., A. Permin, M. Bisgaard, and J.P. Christensen. 2010. Causes of mortality in commercial organic layers in Denmark. Avian Dis. 51: 1241-1250.

61. Swarbrick, O. 1986. Clinical problems in "free-range" layers. Vet. Rec. 118:363.

62. Swayne, D.E. and D.A. Halvorson. 2008. Influenza. Pages 153-184. in Disease of Poultry. Y.M. Saif, A.M. Fadly, J.R. Glisson, L.R. McDougald, L.K. Nolan, and D.E. Swayne, ed. Blackwell Publishing, Ames, IA.

63. Terregino, C., R. De Nardi, V. Guberti, M. Scremin, E. Raffini, A.M. Martin, G. Cattoli, L. Bonfanti, I. Capua. 2007. Active surveillance for avian influenza viruses in wild birds and backyard flocks in Northern Italy during 2004-2006. Avian Pathol. 36:337-344.

64. U.S. Department of Agriculture, Agricultural Marketing Service, National Organic Standards Board Livestock Committee Proposed Recommendation Species-Specific Guidance, October 14, 2011. pp 1-46 http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5094939&acct=nosb. Accessed 18 October, 2011.

65. Van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunstrom, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak et al. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ. Health Perspect. 106: 775-792.

66. Vanderkerchove, D., P. De Herdt, H. Leavens, and F. Pasmans. 2004. Colibacillosis in caged layer hens: characteristics of the disease and the aetiological agent. Avian Pathol. 33:117-125.

67. Van Hoorebeke, S., F. Van Immerseel, J.De Vylder, R. Ducatelle, F. Haesebrouck, , F. Pasmans, A. de Kruif, and J. Dewulf. 2010a. The age of production system and previous Salmonella infections on-farm are risk factors for low-level Salmonella infections in laying hen flocks. Poult. Sci. 89:1315-1319.

68. Van Hoorebeke, S., F. Van Immerseel, J. Schulz, J. Hartung, M. Harisberger, L.Barco, A. Ricci, G. Theodoropoulos,E . Xylouri, J.De Vylder, R. Ducatelle, F. Haesebrouck, F. Pasmans, A. de Kruif, and J. Dewulf. 2010b. Determination of the within and between flock prevalence and identification of risk factors for Salmonella infections in laying hen flocks housed in conventional and alternative systems. Prev. Vet. Med. 94: 94-100.

69. Van Overmeire, I., L. Pussemier, V. Hanot, L. De Temmerman, M. Hoenig, and L. Goeyens. 2006. Chemical contamination of free-range eggs in Belgium. Food Addit. Contam. 23:1109-1122.

70. Vieira, E. D. R., J. P. M. Torres, and O. Malm. 2001. DDT environmental persistence from its use in a vector control program: A case study. Environ. Res. 86:174-182.

71. Vizard, C.G., D.L. Rimmer, T. Pless-Mulloli, I. Singleton, and V.S. Air. 2006. Identifying contemporary and historic sources of soil polychlorinated dibenzo-p-dioxins and polychlorinated dibenofurans in an industrial urban setting. Sci. Total Environ. 370:61-69.

72. Wales, A., M. Breslin, B. Carter, R. Sayers, and R. Davies. 2007. A longitudinal study of environmental salmonella contamination in caged and free-range layer flocks. Avian Pathol. 36:187-197.

Yazwinski, T.A. and C.A. Tucker. 2008. Nematodes and Acanthocephalans. Pages 1025-1056 in Disease of Poultry. Y.M. Saif, A.M. Fadly, J.R. Glisson, L.R. McDougald, L.K. Nolan, and D.E. Swayne, ed. Blackwell Publishing, Ames, IA.

Nutrition affects immunity in poultry

Proceedings of the 2011 International Poultry Scientific Forum, Atlanta, GA, USA, Poultry World, 04 Nov 2011

Nutrition has an important impact on the immune system of a chicken. On the third day of the European Symposium on Poultry Nutrition in Cesme, Turkey, this subject was discussed by three well known scientists in the poultry industry.

Gary Butcher of the University of Florida, College of Veterinary Medicine in Gainesville, USA kicked off the day with the topic “Interrelationship between nutrition and immunity in commercial poultry”.

He told the audience that poultry encounter stressors each day they are alive. These stressors cause hormone changes, declines in feed intake, altered nutrient metabolism and suppressed immune function.

“It is known that through selection on meat production problems occur with the immune system. However, enhancing the immune function has a negative effect on performance. It is a fact that the immune system has a direct negative effect on bird performance,” Butcher said.

Stressors are a part of every poultry operation. Management of these stressors to minimise the stress response in the bird should be the goal of every good poultry manager.

The successful poultry enterprise is the one in which the nutritionist, production manager, veterinarian and other personnel have an understanding of stress and make an attempt to do everything possible to minimise the stressors in the operation.

“A three-way interrelationship exists among nutrition, immunity and stress and in order to totally understand the metabolic consequences that each one has on

bird performance they must always be considered together because of this interrelationship," Butler concluded.

Developing the digestive tract

More fundamental was the presentation of Aharon Friedman of the Section of Immunology, Faculty of Agriculture, Food and Environmental, of the Hebrew University of Jerusalem, Israel.

Due to physical problems Friedman presented his paper through Skype. He talked about "Development of immunity in poultry with special emphasis on developmental adaptations of immunity in the avian digestive tract."

The gut of a hatchling is unprotected against colonizing microorganisms by adaptive immunity during the first few days of life.

Protection during this critical period might be the result of maternal antibody activity or that of the innate immune system. This system appears to be functional at this time, though much work is needed to establish this possibility.

Given that the adaptive immune response is under-developed at hatch, the efficacy of vaccines administered in-ovo or in the hatchling should be considered.

The rational for vaccinating in-ovo is twofold: to immunise the chick as early as possible, and to develop a technology allowing mass vaccination in the poultry industry.

But, if the adaptive immune response is immature in-ovo, how could such a strategy provide immune protection against natural infection in the chick, questioned Friedman.

Ecological managers

A bit closer to practice was the presentation of Peter Ferket, Department of Poultry Science of North Carolina State University, Raleigh, USA who talked about "Nutrition-disease interactions regarding gut health in chickens."

Gut health may be of greatest concern among poultry producers because of its impact on economic sustainability, and their customers concern about food safety and traceability.

"There are ten times more bacteria and other microflora in the gut than there are cells in a chicken," Ferket said. "We are ecological managers, not nutritionists."

Gut health and nutrition are intricately dependent upon one another and it is often difficult to distinguish which one is the predisposing factor.

To resolve gut health problems, one must first be able to identify the nature of a

gut health problem and understand the fundamentals and modifiers of enteric development.

Strategic use of different feed additives can be used to stabilise the enteric ecosystem. These enteric conditioning feed additives include antibiotics, probiotics, prebiotic non-starch polysaccharides, essential oils, organic acids and short-chain fatty acids, and mananoligosaccharide derivatives of yeast cell wall, and microbial enzymes.

“Understanding the mode of action of these feed additives is necessary to design compatible feed additive programs to control gut health,” Ferket ended.

Biomechanical Compromises and Constraints on Locomotion and Breathing in Broiler Chickens

The Poultry Site Newsletter I 10 November 2011

Each year, more than 30 billion broiler chickens are bred for human consumption; 800 million in the UK. Of these animals, up to 30 per cent develop some form of obvious lameness as well as heart and lung problems, costing perhaps £20 million per year in the UK alone, according to the Royal Veterinary College, London.

These problems are linked to selective breeding for rapid growth rates – broilers take only six weeks to reach a slaughter mass of almost 3kg, which has changed from 15 weeks to reach a smaller mass in the 1950s. As a result, the skeletons and other systems of broilers are immature, with potentially compromised abilities to adapt to their environment as they grow to large sizes. Activity levels decline steeply as broilers age. Welfare problems related to inactivity increase with age and there is controversial but building evidence that slaughter-age broilers are in pain. However global food security depends on economical and environmentally-friendly chicken meat; there may be no simple answers to this conundrum.

Dr John Hutchinson, with colleagues Dr Monica Daley, Heather Paxton (finishing a PhD with Dr. Hutchinson and moving on to a postdoc with him next), Dr Jonathan Codd and Dr Peter Tickle (University of Manchester) and colleagues, supported by major chicken breeder Cobb-Vantress, Inc., are beginning a new BBSRC-funded grant. They aim to develop a new scientific framework for understanding how the bodies of broilers change as they grow, focusing on the functions of the legs and their muscles during standing and walking, and the functions of the chest muscles during breathing when standing, sitting and walking. This framework would be founded on an extremely rigorous three-dimensional analysis (using x-rays) of how the skeleton actually is moved by the muscles during locomotion and breathing. It combines cutting-edge techniques for the experimental analysis of gait (including stability) and breathing (including

metabolic energy cost for different activities) with anatomically-realistic 3D computer simulations of how the musculoskeletal system produces observed motions.

Dr Hutchinson says: "We have laid an excellent foundation with our past four years of research on similar topics in avian biology. Now we really want to make a positive impact for the birds and for people, maximally informed by scientific evidence. The technology is now at a point where some really cool science is possible, to get at some very basic questions about what has gone wrong with broiler chickens and how to make that more right. We're going to capitalize on that, and I think everyone will benefit." The team of researchers expects that their novel synthesis of these approaches will allow them to tease apart how the body shape and posture of broilers changes as they grow and how these changes influence standing, moving and breathing. This work should reveal tradeoffs between growth, health and behaviour, by filling a major gap in our understanding of broiler biology. Studies are yet to peer inside living broilers to see how their components work to achieve observed behaviours and how the interactions of these components influence the lives of broilers. Instead, most research has focused on external, qualitative observations of 'lameness' and 'leg weakness' during life or post-mortem diagnoses of numerous specific disorders. Their study aims to redress this imbalance by spanning the gap between functioning organs, organisms and populations of broilers. Hutchinson et al. suspect that, as other studies hint, at two weeks of age broilers are quite adept at locomotion and breathing but these abilities tend to decline at four weeks and approach limits of viable performance at six weeks old. These declines could be driven by the rapid growth of edible breast muscles that make the body 'front heavy', destabilising the animal and making its legs work harder to support it, and concurrently make breathing more difficult. This could lead to fatigue, inactivity and poor health that might have parallels with the human obesity crisis, but again there is no simple solution to it.

Selecting for better nest acceptance

World Poultry I /04 Oct 2011

From January 2012, the EU-wide cage ban for layers will come into practice. This demands a different management approach, specifically for aviary systems, as the behaviour of layers plays a part. Specific selection, such as for nest acceptance, oviposition time and duration of stay in the nest, are important traits for avoiding floor eggs.

In order to meet consumer preferences, breeding goals are constantly being readjusted. A number of different aspects concerning laying performance, egg quality, feed efficiency as well as the health and behaviour of laying hens are considered in the breeding programme of Lohmann Tierzucht (LTZ).

For continuous improvement, more than twenty characteristics are included in the selection index, which is the basis of every breeding programme. In the overall selection index, each characteristic is weighted in relation to market requirements and exactly defined to meet those needs. In recent years, egg producer's demands for good nesting behaviour, especially nest acceptance, have grown, but until now it has been difficult to record the necessary individual bird information.

In order to obtain these data, LTZ developed a completely new testing system together with the Weihenstephan State Research Centre in Freising, Germany. The so-called "Weihenstephan Funnel Nest Box" (FNB), enables hen specific data recording in a non-cage environment. Based on these data, specific selection on nesting behaviour can be carried out.

An extensive article on this selection programme is published in the nr 8 edition of World Poultry, which will appear this month.

Seeking Better Alternative Housing Systems for Poultry
The Poultry Site I November 12, 2011

Back to the future is not the way to go to provide a better environment for laying hens and broilers. While consumer and legal pressures are pushing for alternative to highly intensive systems, modern genotypes have different needs from their ancestors of decades ago, reports Jackie Linden, senior editor of ThePoultrySite, from a recent WPSA symposium on alternative housing of poultry.

By the late 1960s in Europe and North America, poultry production had developed from a small-scale rural enterprise to an economically important branch of agriculture, explained Dr Ernst Fröhlich of the Centre for the Proper Housing of Poultry and Rabbits (ZTHZ) in Zollikofen in Switzerland.

He was making the first presentation at a conference 'Alternative Systems for Poultry – Health, Welfare and Productivity', which was held in Glasgow, Scotland in September, organised by the UK Branch of the World's Poultry Science Association (WPSA). The conference, the 30th in the series, was attended by more than 120 delegates from 26 countries, including Australia, the US, Africa and the Middle East.

For both meat- and egg-type birds, flock sizes increased from the 1960s and production systems, for hygienic and economic reasons, became more intensive, continued Dr Fröhlich. Rearing and housing of laying hens took place in

conventional (battery or unfurnished) cages, while broilers were kept on the floor, systems that have become so familiar across the world.

However, at the same time, public concern for intensively housed birds began to increase, particularly following publications such as 'Animal Machines' by Ruth Harrison in 1963.

As a result, new animal protection laws came into force and agriculture became under increasing pressure to adapt to the welfare concerns of consumers, said Dr Fröhlich.

Alternative systems for housing laying hens have gradually become more popular. They provide greater freedom of movement and facilities for expressing the birds' natural behaviour, including the addition of the 'third dimension' for perching and nesting.

For laying hens in the EU, conventional cages will cease to be allowed from the beginning of 2012, and this type of housing was already banned in Sweden and Switzerland some years ago.

Explaining the broad types of 'alternative' housing systems for layers, Dr Fröhlich said that the old single-level systems, such as the 'Pennsylvania style' are not ideal from the welfare point of view. Although they provide much more space than a cage and offer feeding and nesting areas, they are arranged in such a way that the birds moving between the areas constantly disturb those resting and bouts of aggression can result.

On the other hand, Dr Fröhlich said that aviaries and multi-tier systems offers separate functional areas in three dimensions and the spatial division of the flock means that conflicts between birds are rare. Proper design and construction are vital, he stressed, so that birds do not become trapped or injured.

A further development of this type of system is the winter garden – a covered and netted area outside the house, with plenty of litter, allowing birds more space during the day and fresh air.

The final step is to allow the birds access to pasture or range outdoors during daylight hours. Dr Fröhlich stressed that this free-range area needs to provide cover with trees, shrubs and/or structures to maximise the number of hens using this area.

Dr Fröhlich sees the winter garden as a good option, offering some of the advantages of free-range without the risks.

He said: "Free-range is a risk; you have predators." The resulting injuries and mortality may outweigh the benefits of the additional space from the welfare point

of view.

Turning his attention to broiler production, Dr Fröhlich described the standard system of production as one in a windowless house, with a litter floor, feeders and drinkers.

He said that enrichments can be provided in the form of simple ramps on the floor of the house, which encourage the birds to be more active and offer some shelter beneath. He added that slower growing breeds tend to make more use of these ramps throughout the growing period than the faster-growing ones.

As a further enrichment, newer broiler house may have windows to provide some natural light into the house.

Covered outdoor runs also offer enrichment but they are more suitable for alternative breeds, in Dr Fröhlich's experience.

Production systems for meat birds were introduced that, in addition to higher space allowances, specified maximum rates of growth and feed ingredients.

Free-range systems are rarely for meat birds, apart from Label Rouge production in France and similar schemes.

Dr Fröhlich concluded that time alone will show which type of system for poultry egg or meat production will survive the evolving social and economic pressures on producers and consumers.

Research: Chicken's resilience begins in the egg

World Poultry Net I 05 Jan 2012
Source: Wageningen University

Chickens are more resistant to infection if they are hatched at the right temperature. Feeding them straight after hatching also strengthens their resilience at a later stage, concluded Wageningen UR PhD researcher Irene Walstra.

Walstra looked for ways of increasing the adaptive capacity of laying hens, so as to enable them to respond to pathogens more effectively. She hatched eggs at the optimal eggshell temperature of 37.8 degrees Celsius, after which the chicks had immediate access to food and water. They were then kept in a free-range barn with a dust bath for seven weeks.

Another batch of eggs was hatched at temperatures of between 36.7 and 38.9, did not get immediate access to food and drink, and were kept in a cage. These conditions are common in the poultry sector. When the chicks were exposed to an intestinal parasite at the age of 53 days, the chicks in the first group were affected much less severely. “All the chicks fell ill, but the first group lost less weight than the second group”, says Walstra.

Poultry farmers obtain more resilient laying hens if more care is taken at the hatchery over the temperature in the hatching machine and the living conditions for the young chicks, concluded Walstra. It can be difficult to make the second improvement because standard hatcheries do not have space for chicks to free-range before they are delivered to the poultry farmers.

Walstra calls her experimental research a first step towards an alternative method of improving animal health without using drugs. She does add that the resistance of the laying hens is also influenced by the conditions in the barn, the virulence of the pathogens concerned and the poultry farmer's management.

Research on Horizontal Transmission of Salmonella in Caged and Floor Housed Hens

* Hannah, J.F.*et al* Horizontal Transmission of *Salmonella and Campylobacter* Among Caged and Caged-Free Laying Hens. Avian Diseases. 55:580-587. (2011)

The September 2011 edition of Avian Diseases contains an article of significance to the U.S. egg production industry with respect to transmission of Salmonella. Hens were infected under laboratory conditions with either Salmonella Typhimurium or Salmonella Enteritidis. Either oral, intravaginal or intracolonic routes were used.*

Hens were held for seven days after inoculation and were then comingled with susceptible hens in either cages, or on slats or on litter. After ten days of comingling hens were sampled using drag swabs. Twelve days after the initiation of the contact component of the trial all hens were sacrificed and organs were examined for the presence of *Salmonella* using routine bacteriology.

Approximately 15% of the non-challenged contact hens in cages yielded *Salmonella* from the cecum compared to 20% on slats and 30% on wood shavings. Among the challenged hens, 20% yielded *Salmonella* from the cecum and 13% from the lower reproductive tract. The challenged hens on slats yielded *Salmonella* in the range of 12% through 25% from the cecum, spleen, liver, and the upper and the lower reproductive tracts but not from ovarian follicles. Hens on wood shavings yielded *Salmonella* ranging from 8% through 15% from the same sites but again not from follicles.

The significant conclusions from the trial were:

Horizontal transmission was lowest in cages followed by slats. Floor systems were the most likely to support horizontal transmission between shedder hens and susceptible contacts.

The rates of recovery of *Salmonella* Enteritidis from tissues following infection or from contact hens were extremely low. This is consistent with previous literature reports which show ranges of 2.5% to 7% recovery following administration of large doses of *Salmonella* Enteritidis (10^9 cfu/ml) which is far in excess of what might occur under commercial housing conditions.

The fact that hens appear relatively resistant to intestinal colonization and extension to organs following controlled infection suggests that protection can be enhanced by durable immunization and administering combinations of prebiotics and probiotics in feed. It is hoped that the research team at the Richard B. Russell Agricultural Research Center will review these aspects of protection in subsequent studies since this would have profound commercial implications.

The significance of this article is that it refutes the conclusions derived from studies in Europe that implicate cages as a risk factor for SE infection in comparison to floor systems.

Addressing the Challenges of Alternative Housing Systems for Poultry

The Poultry Site, November 2011
'Alternative Systems for Poultry – Health, Welfare and Productivity', organised by the UK Branch of the WPSA

Development of Furnished Cages for Laying Hens

"Directive 99/74/EC has made the biggest impact on animal welfare in the EU in the shortest time," said Arnold Elson of ADAS Gleadthorpe in the UK in the introduction to his presentation, which was prepared with Dr Ragnar Tauson of the Swedish University of Agricultural Sciences.

The majority of hens have been – or will be – moved to furnished cages (FC) as a result of the Directive, which comes into effect on 1 January 2012, he said, increasing production costs. In fact, FC were conceived more than 30 years ago when welfare deficiencies of barren conventional cages were realised. Their use was intended to enhance hens' behavioural repertoire and welfare without the disadvantages of non-cage and extensive housing.

Since then, their design has been refined and improved, resulting in much improved performance and hen welfare. With 750 square centimetres per bird, FCs offer hens more space than conventional cages, as well as perches, nest boxes and a scratching area, in addition to the feed trough and drinkers.

Group size has been an important consideration, said Mr Elson, especially in relation to variation in damaging pecking in differing genotypes, with or without beak treatment. Regulations on beak trimming vary from country to country and have affected cage design, group size and management.

The trend has been to move from small group FCs – used mainly in Scandinavia – to larger group medium and large FCs subsequently developed in other countries, with the majority of birds in groups of up to 60 birds. FCs are have been estimated to increase production costs by about eight per cent over conventional battery cages.

The group sizes have generally performed well under good management, said Mr Elson. Interventions such as beak trimming and controlled light intensity are most often applied in FCLs and to brown genotypes.

Large-scale studies, in which performance and welfare have been compared across all currently available systems, enable us to conclude that they are at least as good in FCs as in any other system and probably superior.

Council Directive 19999/74/EC, which requires the demise of all conventional cages in the EU by January 2012, has accelerated the move into FCs and it is clear that the majority of laying hens in Europe will be housed in them for the foreseeable future, with the aim of enhancing laying hen welfare.

FCs have potential for further development as research reveals more information of optimum group/cage sizes, the provision of litter, the elimination of red mites and ways to reduce feather pecking and cannibalism, concluded Mr Elson.

Comparison of Production, Health and Welfare of Hens in Cages and in Alternative Systems

'Alternative Systems for Poultry – Health, Welfare and Productivity', organised by the UK Branch of the WPSA

Bas Rodenburg of Wageningen University in the Netherlands made the focus of his paper a comparison of the performance, welfare, health and hygiene of laying hens in different types of non-cage systems, focusing on barn, free-range and organic systems. In a paper written with Drs K. De Reu and F.A.M. Tuyttens of the Belgian Institute for Agricultural and Fisheries Research, he contrasted non-cage systems with each other and with cage systems. He concluded that large differences have been identified, both between and within systems.

Moving from conventional cages to furnished cages, barn, free-range and organic systems results in increasing environmental complexity, he said, which is positive for some aspects of hen welfare but also increasing risks for performance, health and hygiene, which may be negative for other aspects of

hen welfare.

For the improvement of hen welfare in non-cage systems and furnished cages, Dr Rodenburg recommends that the focus should be on creating a better match between the animals and their environment. Good examples are the development of new housing designs, such as the Rondeel and Plantage, which combine the benefits of non-cage systems with improved performance, health and hygiene status.

He concluded that further, promising approaches in animal breeding and optimised rearing environments will yield major improvements in the welfare of laying hens in non-cage systems and furnished cages.

"The right birds for the right systems" is key, Dr Rodenburg said in summing-up.

Housing and Management of Broiler Breeders and Turkey Breeders

'Alternative Systems for Poultry – Health, Welfare and Productivity', organised by the UK Branch of the WPSA

Housing and management of broiler breeders and turkey breeders in Europe were described by Dr Ingrid de Jong of Wageningen University for broiler breeders and turkey breeders were covered by Tim Burnside of Aviagen Turkeys, standing in for his colleague, Dr Magnus Swalander.

The majority of broiler breeders in Europe are the standard, fast-growing genotype but 18 to 20 per cent of the birds are dwarf parental females that produce standard and alternative (medium- or slow-growing) broilers, said Dr de Jong.

Broiler breeder housing systems are very similar: birds are generally kept in climate-controlled houses with litter floor during the rearing period and partially slatted floors during the production period. There is a low percentage of birds in cages and alternative systems are not used. Males and females are reared separately until 18 to 21 weeks of age and then transferred to he production farm where they are housed together until 60 to 65 weeks of age.

The restricted feeding regime during rearing is generally seen as one of the major welfare issues in broiler breeders as it leads to chronic hunger and frustration in feeding motivation. Aggressive behaviour of the males towards the females at mating was also mentioned by Dr de Jong as a concern, which can be partly alleviated by lower stocking density.

The majority – more than 95 per cent – of turkey breeders in Europe are of either heavy or heavy-medium genotype with white plumage, explained Dr Burnside. The remainder of the turkey market consists of small strain white or coloured

birds for whole bird seasonal production. Both conventional large-strain turkeys and small strain traditional turkeys are used for outdoor/alternative production systems.

Rearing of breeding turkeys is floor-based on deep litter and predominantly in environmentally controlled housing. Males and females are reared separately until 29 weeks of age and then transferred to the laying facility. Male parent stock id selected at 16 to 18 weeks of age, paying attention to health, fitness, plumage and conformation.

Laying facilities are either open-sided houses or controlled-environment houses for breeding females and typically environment-controlled housing for breeder males. Breeding turkeys are kept in production until 56 to 60 weeks of age, i.e. 24 to 38 weeks of production. Quantitative feeding restriction is applied to breeder males from selection to the end of production to maximise fitness and production. Breeder females are fed unrestricted throughout rearing but a lower protein diet to avoid the hens becoming fat. Injurious pecking is generally seen as the mot important welfare issue in flocks where beak trimming is not applied.

"Welfare is a key priority for breeders and the industry," concluded Dr Burnside.

Housing and Management of Layer Breeders in During Rearing and Production

'Alternative Systems for Poultry – Health, Welfare and Productivity', organised by the UK Branch of the WPSA

Housing and management of layer breeders need to be right, otherwise farmers are unable to take advantage of the genetic potential and high economic value of the hens, said Dr Hans-Heinrich Thiele of Lohmann Tierzucht in Cuxhaven, Germany.

He explained that a good start is secured by optimal brooding conditions, high feed quality and appropriate management in the early life of chicks.

The development of adequate eating capacity during the later rearing period and a fine-tuned light stimulation were factors that he identified as important for a good start in the production phase.

Dr Thiele stressed that the birds must be adjusted to the different housing systems for layer breeders; they need to be trained to be able to access easily the feed, water and nest boxes provided, and the correct vaccination schedule will prepare the birds for the different disease challenges they face in the production environment.

Once in production, nutrient requirements can be met by a phase feeding programme. Good hatching egg quality can be achieved by avoiding floor eggs and appropriate egg handling.

Dr Thiele offered a number of tips to prevent floor eggs, including ensuring easy access to all the nests without dark corners or draughts. Some lighting in the nests may help, he suggested, as does water provided near the boxes and barriers to prevent more dominant birds from excluding the others from that area. Excessive litter should be avoided on the floor. Also important, according to Dr Thiele, are to ensure birds are not disturbed while they are laying and to collect any floor eggs regularly – several times a day, if necessary.

Alternative Systems for Meat Chickens and Turkeys

Legislative and assurance scheme requirements for standard and alternative indoor and outdoor broiler and turkey production systems were described by Dr Tracey Jones of welfare campaigners, Compassion in World Farming, in a paper co-written with Dr Jutta Berg of the FLI in Celle, Germany.

She explained that health and welfare are protected to various extents by a series of input requirements, which cover stocking density, light, environmental control parameters, environmental enrichment, permitted mutilations and growth rate. Outcome measures, on the other hand, are usually related to physical well-being and tend to highlight flocks that performed poorly. Success depends on the effectiveness of the input and output measures, the reporting structure and remedial action taken.

Alternative systems represent a low market share of broiler and turkey production in the EU – approximately 10 and 30 per cent, respectively – and generally, production costs are higher, said Dr Jones.

Free-range and organic systems are perceived as having the potential to provide good living conditions and reduce environmental pollution, she continued, but concerns have been raised over bird health (Campylobacter infection), welfare (higher foot lesions and breast blisters and lack of outdoor ranging), product quality and consumers' willingness to pay.

Research shows that breed suitability is one of the most important factors determining welfare in alternative systems, particularly for broiler chickens. Dr Jones recommended that more robust and hardy breeds with lower growth rates should be used as these birds are better suited to a wide range of environments and perform well on less energy-dense diets.

The quality of the diet, particularly in relation to essential amino acids and protein balance and the free-range environment (particularly in relation to natural cover

outdoors) are also highly important for both broilers and turkeys, she said.

The meat from slow growing broiler breeds is more suited to the whole bird market (as opposed to portioned or further processed) and generally contains less fat and more protein than from conventional breeds, according to Dr Jones. Consumers tend to be unable to differentiate chicken products from alternative system by odour and taste but can differentiate by appearance and texture.

"Alternative systems can deliver," concluded Dr Jones, adding that breed suitability and the quality of the outdoor area are important considerations. For the future, she highlighted the need to focus on balancing organic diets to reduce feather pecking and a need for clearer labeling so consumers can make informed decisions about their purchasing of poultry meat.

Identification of key performance indicators for on-farm animal welfare incidents: possible tools for early warning and prevention

Irish Veterinary Journal 2011, 64:13 Author/Organization: Patricia C. Kelly, Simon J. More, Martin Blake and Alison J Hanlon Publication: 8 November 2011

The objective of this study was to describe aspects of case study herds investigated by the Department of Agriculture, Fisheries and Food (DAFF) in which animal welfare incidents occurred and to identify key performance indicators (KPIs) that can be monitored to enhance the Early Warning System (EWS). Despite an EWS being in place for a number of years, animal welfare incidents continue to occur. Questionnaires regarding welfare incidents were sent to Superintending Veterinary Inspectors (SVIs), resulting in 18 herds being chosen as case study herds, 12 of which had a clearly defined welfare incident date. For each study herd, data on six potential KPIs were extracted from DAFF databases. The KPIs for those herds with a clearly defined welfare incident date were studied for a consecutive four year window, with the fourth year being the 'incident year', when the welfare incident was disclosed. For study herds without a clearly defined welfare incident date, the KPIs were determined on a yearly basis between 2001 and 2009.

We found that the late registration of calves, the use of on-farm burial as a method of carcase disposal, an increasing number of moves to knackeries over time and records of animals moved to 'herd unknown' were notable on the case farms.

Four KPIs were prominent on the case study farms and warrant further investigation in control herds to determine their potential to provide a framework for refining current systems of early warning and prevention.

Poultry

Electric stunning and experience with electro-convulsive therapy

World Poultry Net I16 Dec 2011

Researchers Zivotofsky and Strous from Israel provided a perspective on the electrical stunning of animals: Are there lessons to be learned from human electro-convulsive therapy (ECT)?

Animals have been slaughtered by humans since time immemorial. Over the last few generations attention has been focused on minimising the animal's pain and suffering during slaughter.

Based on the assumption that loss of consciousness due to electrical stunning combined with exsanguination is a humane technique of slaughter, this procedure has become one of the most widely employed methods in commercial meat production, being used in almost all species.

In recent years, some shortcomings with this method of minimising the animal's suffering have been noted.

Electrical stunning is probably more akin to human electro-convulsive therapy (ECT) than to epilepsy, and some of the negative aspects of unmodified ECT may be present during electrical stunning, further questioning the use of electrical stunning in the slaughter of animals.

Highlights of this research:

• Electrical stunning is a widespread method of commercial pre-slaughter stunning
• Effective electrical stunning may be difficult to achieve in practical conditions
• Effective stunning is particularly difficult to achieve with poultry
• Electrical stunning parallels unmodified human electro-convulsive therapy (ECT)
• Unmodified ECT is considered cruel in humans and is thus prohibited

Other

Effects Of Stockperson Behaviour On Animal Welfare & Productivity

TheCattleSite
November 28, 2011

Speaking at a recent Boehringer Animal Welfare Forum, Professor Paul Hemsworth, Director of the Animal Welfare Science Centre discussed human - animal interactions in livestock production.

A stockpersons attitude and behaviour has a significant effect on an animals fear, welfare and productivity. Professor Hemsworth and his colleague Professor Grahame Coleman from the Animal Welfare Science Centre focus their research on how these attitudes and behaviours affect animal welfare, and subsequently productivity. Capacity, willingness and opportunity all affect a stockpersons work performance, said Prof Hemsworth. Capacity is knowledge and technical skills, whilst willingness is attitudes, motivation and work ethics. Opportunity refers to the opportunity to carry out the task - which is affected by work conditions, co-workers, time available etc.

The concept of human-animal relationships

Human-animal relationships can be assessed by looking at each partner's perception of the other. Frequent and intense interactions between both parties will undoubtedly develop a relationship. So an animals perception of its relationship with humans can be studied by examining the behavioural and physiological response of the animal to humans. Similarly, the humans perception of this relationship is found by examining the behaviour and attitude of the human towards the animal. Prof Hemsworth said that studies often focus on the animal's fear responses to humans - because of the implications on welfare.

A model of human-animal interactions in livestock industries

Handling studies

A mixture of handling studies and field observations have been carried out, which provide significant insights into human-animal relationships, said Prof Hemsworth. Assessing an animals relationship is done through a variety of tests. *Behavioural tests, such as response to flight distance*: response to stationary human, response to moving human, response to actual handling *Physiological tests*: such as heart rates and corticosteroid (stress) responses etc. Results have shown a substantial variation in fear responses and stockperson behaviour between farms, said Prof Hemsworth. Human behaviour elicting certain animal responses have been measured as positive or negative. A negative handling behaviour, such as slaps, hits, fast movements, shouting and noise will cause an increase in fear in the animal, resulting in avoidance, stress and handling difficulties. Positive stockperson behaviours, such as pats, strokes, talking, hand resting on the back, slow and deliberate movements will reduce the animal’s level of fear of humans and result in animals which are less stressed and are easier to handle. Prof Hemsworth's own studies, as well as more recent and past

studies all show a strong correlation between negative stockperson behaviour and an increase in fear of humans. These effects have been demonstrated in many farm animal species.

Negative Handling: Fear and Stress

Research by Breurer et al in 2003, looked at handling, fear and stress physiology in dairy cows. Dairy cows were exposed to five minutes of handling a day, for five weeks. Some animals in the study were exposed to negative handling, whilst others received positive handling. To measure the cows fear and stress, avoidance of humans (flight distance), acute cortisol response (at five minutes after human exposure) and basal free cortisol concentrations (taken in the morning) were measured. Animals exposed to positive handling had a much shorter flight distance (humans could get much closer to the animal before it withdrew).As well as a shorter flight time, acute cortisol responses were significantly lower, compared animals that had received negative handling. Interestingly, the research showed that negative handling of the dairy animals resulted in higher basal free cortisol concentrations the following morning - suggesting that the animals were significantly affected by the five minutes of negative handling received the day before. A study of cortisol concentrations in gilts by Prof Hemsworth, saw that concentrations of basal plasma cortisol were lower in gilts handled positively, than in gilts handled negatively.

Negative Handling: Animal Productivity

In growing pigs, research has shown that negative and inconsistent handling increases fear responses. One study by Prof Hemsworth looks at growth rates in pigs. His study showed that the growth rate of positively handled pigs was 455 g/day, whereas it was only 404 g/day in pigs negatively handled. The growth rates for inconsistent pigs was 420 g/day. In this situation, the growth rate was reduced due to the animals stress response (cortisol concentrations were elevated in inconsistent and negatively handled pigs), said Prof Hemsworth. A similar study was carried out in laying hens, looking at the effects of negative handling (sudden and unpredictable movements in front of the pens) and positive handling (an extra two minutes spent in front of the cages, and slow deliberate movements). Hen time at the front of the cage was measured, with less time at the front of cage took as avoidance of human contact. Stress responses and egg production were also measured. The results show that positive handling of birds means that the hens were keen to have increased human contact (less fearful), spending more time at the front of the cage. The corticosterone stress levels were much higher in hens handled negatively, than in positively handled hens. Subsequently egg production in the hens was eight per cent higher in hens that had a positive human-animal relationship. The number of studies across species with strong correlations between stress and negative handling, leaves no doubt that negative handling evokes stress, affecting animal welfare and production, said Prof Hemsworth.

Negative handling: Animal Health

As mentioned above, studies have shown that negative handling affects an animal's fear of humans, leading to stress, which consequently affects health. One study shows that socialised (used to positive human contact, so less fear) birds had higher feed conversion efficiency. In this same study, birds that were less socialised (more fear of humans) had higher lesions and deaths, as well as overall poorer health. Prof Hemsworth says this is due to the response of immune system, suppressing antibodies when an animal is stressed, leading to poor health. A different study, carried out on veal calves, looked at average daily gain and mortality. Fast movements by stockpersons were negatively associated with daily liveweight gain. As well as this, negative behaviour was seen to increase mortality, although unit size was a large variable in this study. Longer flight distances in dairy cattle, also have a positive correlation with lameness in dairy cattle. In a study of 36 dairy heifers, 48 per cent of heifers with a flight distance of 4.8m (to humans) were lame, and on average milk yields were 1.3 kg/day less, than those with a shorter flight distance. To compare, of cows with a flight distance of 2.81m (those that were less fearful), only six per cent showed signs of lameness. On pasture based systems, Prof Hemsworth said that lameness in dairy cows was affected by two significant factors - the condition of farm tracks and farmers' patience in the dairy, ie. their behaviour towards cows.

Improving human-animal relationships

Changing stockperson attitudes

What is an attitude, asks Prof Hemsworth. It is something that affects our behaviour and although they are stable and resistant, attitudes are learnt. They are shaped through direct and indirect experiences, therefore throughout one's lifespan, attitudes can be changed. Professor Hemsworth says to change stockperson behaviour, it is important to target attitudes as well.

Cognitive-behavioural training

Evidence from studies carried out by Prof Hemsworth and colleagues suggests that stockperson training can improve animal productivity and welfare. To change the behaviour of stockpeople towards farm animals ultimately requires:

- targeting the beliefs that underlie the behaviour,
- targeting the behaviour in question, and
- then maintaining these changed beliefs and behaviours.

One study looked at the benefits of cognitive-behavioural training on dairy units. The key variables measured were stockperson attitudes, stockperson behaviours, fear of humans and animal productivity.The study demonstrated that training significantly improved stockperson attitudes. Training also halved stockperson negative behaviour towards cattle. Whilst the fear responses of cows didn't change much, the changes were small but significant, said Prof Hemsworth. Flight distance did not decrease a lot, but milk cortisol levels did often decline. A second study looked at the effects of training on cow productivity at 94 dairy farms. After training, which targeted stockperson attitudes and

behaviour, milk yield per cow increased, as did the protein and fat content of the milk produced.

Stockperson selection

Some studies, by the Animal Welfare Science Centre, have looked at how the selection of a stockperson can improve animal welfare. Measuring stockperson characteristics prior to employment, may give employers an idea of stockperson attitudes and consequently behaviour towards animals. Concluding, Prof Hemsworth said that the role of a stockperson in animal welfare and productivity should not be underestimated. The studies in this article are just a few of the many that have been carried out. The outcomes highlight how important the role of the stockperson is in developing positive human animal relationships, and consequently improving animal welfare and productivity.

A Comprehensive Approach to Animal Welfare Science

The Pig Site, December 18, 2011
Harold Gonyou, PhD, Jen Brown, PhD

The different approaches to farm animal welfare are explained by Drs Harold Gonyou and Jen Brown in the latest newsletter from the Prairie Swine Centre in Canada.

Concern for animal welfare is evident at all levels of swine production, from producers and industry to society and consumers, and takes different forms at each level. For the individual producer, it involves daily decisions on the basic care of animals – from feeding and general management, to the quality of health checks and maintaining vaccination protocols.

Within the pork industry, concern for animal welfare takes the form of codes of practice and quality assurance programmes designed to define acceptable industry standards for the care and management of animals. From a societal perspective, concern for animal welfare is shown in laws governing major issues such as humane slaughter and housing practices, as well as in the purchasing choices of individual consumers.

Few consumers know, or are able to select, the farm from which they obtain their food.

Their satisfaction with their food relies on their confidence in the industry which produces it. As such, the importance of animal welfare has increased and with it, the need for producers and the livestock industry to demonstrate good care. The field of animal welfare science arose alongside these changes as a tool to help address questions related to management practices that affect the physical and

psychological well-being of animals. This article describes general perspectives in animal welfare science, it explores the measures used in welfare science, and how these measures are used to evaluate management practices.

As David Fraser of the University of British Columbia describes in his recent book, Understanding Animal Welfare (2008), animal welfare is generally viewed from three philosophical perspectives, with each perspective emphasising different components of welfare.

One approach to animal welfare examines how well animals function in their environment. The 'functional approach' assumes that if animals are healthy and productive, their welfare must also be good, and uses measures related to growth, reproduction and health (or absence of poor health) to demonstrate good welfare. Physiological measures indicative of stress are also used to demonstrate how well animals are functioning in their production system.

The functional approach can be applied to plants just as well as it can to animals, yet we are more concerned about the welfare of animals than that of plants. The reason for this is that animals are sentient, that is, they have feelings. We recognise that animals can feel pain, experience fear, and have a sense of comfort and discomfort. A second component of animal welfare relates to these 'affective states', or how animals feel. This approach emphasizes the importance of emotional states and the feelings of animals, using measures such as pain, fear and discomfort (or alternatively, positive emotions) as indicators of well-being.

The third component of animal welfare is known as the 'natural approach'. Through thousands of years living in the wild, our animals have relied on their natural responses to cope with environmental challenges. When they encounter similar challenges in our production systems, they will attempt to use these same natural responses to attempt to cope. Among other things, our animals will use exploratory behaviour to become familiar with their environment, to adapt their social behaviour to alleviate competition, and use thermoregulatory behaviour to avoid cold or extreme heat. If the animal is unable to express these behaviours, it will become frustrated and stressed. It may be able to express the behaviours but be ineffective in coping because a critical part of the environment is missing, for example, a wallow (cooling device) in hot conditions. In some cases, the behaviour may be harmful, such as when attempts to root for food result in injury. The natural approach considers how well the system accommodates the responses of the animal. Its motto can be expressed as 'fit the farm to the animal, not the animal to the farm'. Freedom of movement is a critical component of the natural approach to animal welfare.

While these approaches – 'functional', 'affective states' and 'natural' – can be used separately, when used alone they run the risk of jeopardising other components of animal welfare. Rather than placing our emphasis on any one

component of animal welfare, we should look for systems that overlap and meet a comprehensive definition: a system in which an animal functions well, in which positive feelings outweigh negative, and in which it can express its natural behaviour in an effective manner.

The comprehensive definition of animal welfare meets the approval of most members of society. It is also evident in the Five Freedoms (Table 1), which are accepted guidelines for animal well-being used by many animal production organisations. In the current revision process for Canadian Codes of Practice, for pigs and other species, the mandate includes this comprehensive approach. The challenge to modern producers will be to achieve these goals in a production system that is also efficient and profitable.

From a research perspective, the challenge to scientists at Prairie Swine Centre is to identify management practices that can optimise animal welfare while at the same time maintaining or improving productivity, efficiency and profitability.

This is the first in a series of articles using animal welfare science to address production issues in modern pork production.

References

Fraser, D. 2008, Understanding Animal Welfare: the science in its cultural context. Wiley-Blackwell, Hoboken, NJ.

Farm Animal Welfare Council, 1979,
December 2011

Intestinal Barrier Function As Indicator Of Welfare

The Fish Site, November 2010

This study by Henrik Sundh, Bjorn Olav Kvamme, Frode Fridell, Rolf Erik Olsen, Tim Ellis, Geir Lasse Taranger and Kristina Sundell suggests that the intestinal barrier function of Atlantic salmon post smolts is reduced by common sea cages environments. It may also be used as a physiological indicator of welfare.

Fish farmed under high intensity aquaculture conditions are subjected to unnatural environments that may cause stress. Therefore awareness of how to maintain good health and welfare of farmed fish is important.

For Atlantic salmon held in sea cages, water flow, dissolved oxygen (DO) levels and temperature will fluctuate over time and the fish can at times be exposed to detrimentally low DO levels and high temperatures. This experimental study investigates primary and secondary stress responses of Atlantic salmon post smolts to long-term exposure to reduced and fluctuating DO levels and high water temperatures, mimicking situations in the sea cages. Plasma cortisol levels

and cortisol release to the water were assessed as indicators of the primary stress response and intestinal barrier integrity and physiological functions as indicators of secondary responses to changes in environmental conditions.

Results

Plasma cortisol levels were elevated in fish exposed to low (50 per cent and 60 per cent saturation) DO levels and low temperature (nine degreesC), at day 9, 29 and 48. The intestinal barrier function, measured as electrical resistance (TER) and permeability of mannitol at the end of the experiment, were reduced at 50 per cent DO, in both proximal and distal intestine.

When low DO levels were combined with high temperature (16degreesC), plasma cortisol levels were elevated in the cyclic 1:5 h at 85 per cent:50 per cent DO group and fixed 50 per cent DO group compared to the control (85 per cent DO) group at day 10 but not at later time points. The intestinal barrier function was clearly disturbed in the 50 per cent DO group; TER was reduced in both intestinal regions concomitant with increased paracellular permeability in the distal region.

Conclusions

This study reveals that adverse environmental conditions (low water flow, low DO levels at low and high temperature), that can occur in sea cages, elicits primary and secondary stress responses in Atlantic salmon post smolts. The intestinal barrier function was significantly affected by prolonged hypoxic stress even when no primary stress response was observed.

This suggests that intestinal barrier function is a good experimental marker for evaluation of chronic stress and that it can be a valuable tool to study the impact of various husbandry conditions on health and welfare of farmed Atlantic salmon.

Economics and farm animal welfare

News Release, 7 December 2011

UK--The Farm Animal Welfare Committee (FAWC) today launched its Report on Economics and Farm Animal Welfare. The aim of this Report is to explore the relationships between economics and farm animal welfare, and to identify mechanisms by which economic drivers might be exploited to enhance farm animal welfare.

Professor Wathes, Chairman of FAWC, said: “In investigating our subject, we have found that issues in economics are just as complex as those in science. We recognise that political decisions about the welfare of farm animals have to

account for economics – in its broadest sense – as well as sociological, technical and other factors."

He continued: "The Report argues that economics can help us to understand the relationship between animal and human welfare. It considers both micro- and macro-economic questions about livestock farming and the quality of life of farm animals, i.e. those relating to profitability on the farm and trade, respectively." Professor Wathes concluded that: "FAWC"s advice is that Government has a crucial role to play in maintaining an acceptable standard of farm animal welfare. The quality of life of farm animals cannot be left to the free market because economic forces are powerful and vested interests many-fold. The Report argues strongly for the introduction of a „Welfare Stewardship Scheme". This will ensure that the Government"s objectives for the welfare of farm animals match those of citizens, including many consumers and others in the food supply chain."

The Report provides/assesses:
· an overview of economics (part II);
· drivers for decision-making at the farm level and how the financial environment of livestock farming has varied (part III).
· whether welfare improvements at farm level can be self rewarding through improved animal performance or whether they require to be incentivised by other external drivers (part IV);
Chairman: Professor Christopher Wathes, BSc, PhD
FAWC website: http://www.defra.gov.uk/fawc
· how the market currently rewards welfare initiatives, identifying the drivers and constraints in this process (part V);
· the policy instruments available for Government intervention if welfare is considered as a public good (part VI);
· international issues (part VII);
· decision making at farm level in order to identify the effects that economic pressures have had on welfare in the past (part VIII); and
· the most effective drivers to future animal welfare improvement

U of Guelph livestock centre to kick off with dairy phase

Canadian Cattlemen, *Jan 13, 2012*

Development of a new University of Guelph livestock research centre, expected to model sustainable systems in animal agriculture, will start in the dairy sector.

The university on Wednesday announced plans for the Research and Innovation Centre, Dairy Phase, to be built at Elora, the current site of one of the school's 14 off-campus research stations, northwest of Guelph.

Other

Construction of the first phase of the new complex, involving both new facilities and renovations, is expected to begin later this year, the university said in a release. Specific costs for this phase weren't released Wednesday.

Future phases may include research facilities for swine, poultry and beef, the university said.

"This world-class facility will position Ontario at the forefront of innovation and technology development in agri-food, particularly for livestock research," said Rich Moccia, the university's associate vice-president for strategic partnerships.

"It's an excellent example of the power of university, government and industry collaboration."

Specifically, the dairy phase will be developed in a partnership between the university, the provincial ag ministry and the province's dairy industry, through the Dairy Farmers of Ontario.

DFO chairman Bill Emmott, a Brantford-area dairyman, said his group's involvement "represents a firm commitment to collaborative research with our industry, government and university partners."

The new centre is expected to provide 25 full-time jobs at Elora, offering "cutting-edge technologies and infrastructure" and bringing together scientists from several disciplines to study rural/urban environmental, social and economic issues.

Research at the new centre is expected to cover human health; food safety; animal welfare, productivity and reproduction; new products and procedures; and bio-engineering and renewable energy.

The centre is also expected to use resources such as feed, water and energy more efficiently, and to spur development of new "rural knowledge centres" for bio-based products and green technologies, the university said.

The partnership between the university and ag ministry on projects such as this "promotes a research culture that contributes economically, environmentally and in human capital to Ontario," Moccia said.

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