Newsletter

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> EDITORIAL

Lameness is a growing problem in modern poultry and one of the significant causes of mortality in broilers. It affects mobility of the birds and is usually related with pain. Lameness will cause birds to suffer and limit their natural movements, likely resulting in reduced feed and water intake. Leg disorders and lameness adversely affect the performance and wellbeing of poultry while increasing morbidity and mortality, which cause significant economic losses to the poultry industry. Some approaches to reduce the incidence of lameness are available to the industry but could probiotics also have an impact? The most common cause of lameness in commercial broilers is bacterial chondronecrosis with osteomyelitis (BCO), formerly known as femoral head necrosis. Bacterial chondronecrosis with osteomyelitis is caused by bacteria that reach the joints via the bloodstream and grow in the growth plates of growing bones thus causing damage. Bacterial chondronecrosis with osteomyelitis causing bacteria can enter the bloodstream via translocation from the gastrointestinal tract. Earlier studies have already established the positive effect of Biomin® IMBO on gut health. As good gut integrity lessens bacterial translocation from the gut, it was hypothesized that the feeding of an effective synbiotic like Biomin® IMBO could reduce the incidence of lameness caused by BCO. Latest research findings from the Department of Poultry Science, University of Arkansas confirmed this hypothesis and revealed that the prophylactic feeding of Biomin® IMBO to broilers reduced significantly the incidence of lameness. The results of this study were published in the April, 2012 issue of "Poultry Science" and are now summarized in this Newsletter.

Enjoy reading

Michaela Mohnl

Biomin® probiotic product line

The poultry industry with its modern production lines places great demands on the birds' musculoskeletal system in terms of growth rates for broilers and egg production for laying hens. Any insufficiencies in the birds' nutrition or management will often lead to musculoskeletal diseases, which are normally characterized and diagnosed by lameness. Lameness and gait abnormalities in different poultry species are considered diseases of high significance not only as a result of its welfare implications on birds, but also due to the financial losses to the poultry industry as a result of birds downgrade and increasing birds' market age.

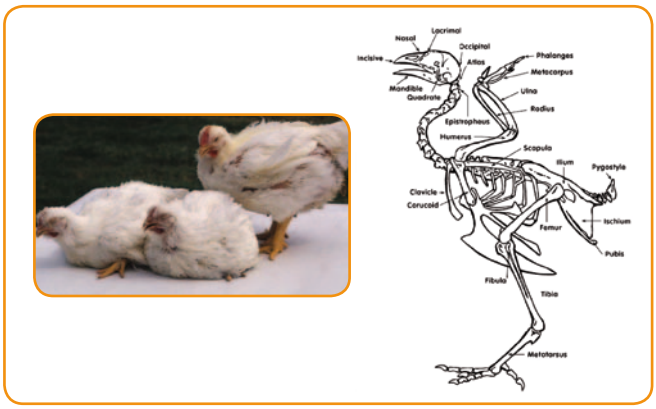
Efficacy of Biomin® IMBO for Reducing Lameness in Broilers

Causes of lameness in various poultry species

The incidence of lameness has recently started to increase in poultry for many reasons. For instance, the main cause of lameness in broilers in the 1980s was tibial dyschondroplasia (TD), in the 1990s the emergence of infectious bursal disease (IBD) with its immunosuppressive nature caused high incidence of bones and joints bacterial infection. A few years later, the removal of meat and bone meal from poultry diets and increasing levels of pollution led to calcium and/or phosphorus deficiencies. In addition, after the EU ban on antibiotic growth promoters (AGPs) in 2006 (EC council regulation No 1831/2003), incidences of lameness and gait problems have increased.

Many risk factors could be associated with the occurrence of lameness in birds and the condition is usually multifactorial. These factors include birds' genotype, sex, age, growth rate, body weight and the length of dark periods in the lighting system used.

For instance, younger, lighter female birds of slower growth tend to have lower incidences of lameness than older, heavier male birds particularly if these birds are subjected to shorter dark periods. Several causes can result in lameness in poultry including viral infections of soft tissues, bacterial infections of skeletal and soft tissues, and skeletal deformities.



Bacterial chondronecrosis with osteomyelitis

The most common cause of lameness in commercial broilers is bacterial chondronecrosis with osteomyelitis (BCO). The term BCO encompasses necrotic degeneration and microbial infection primarily within the proximal heads of the femur and tibia. Femoral head necrosis/BCO is caused by bacteria that reach the joints via the blood vessels that penetrate the bones to nourish the bones and the cartilages. The translocated bacteria adhere directly to the cartilage matrix preferably in the growth plates of growing bones, where they are harbored in microfractures.

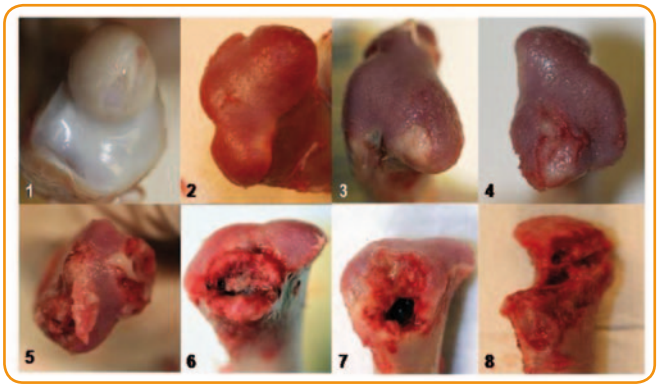


Figure 1 *- Stages of proximal femoral head degeneration leading progressively to bacterial chondronecrosis with osteomyelitis (BCO): 1 Normal proximal femoral head; 2 Femoral head separation (FHS: epiphyseolysis); 3-5 Progressive necrosis, ulceration, erosion and fracturing of the growth plate (femoral head transitional degeneration, FHT); 6-8 Perforation, fracturing and necrosis/osteomyelitis of the femoral head (femoral head necrosis, FHN). (Courtesy R.F. Wideman)*

As the bird's immune system cannot access these microfractures, the bacteria grow rapidly and begin destroying bone minerals (*Figure 1*). This occurs primarily in the hip joints, proximal femur or proximal tibia. The damage caused by the festering of BCO bacteria leads, first to subclinical lesions and ultimately, if unchecked, to lameness.

Certain bacteria like *E.coli* and *Staphylococcus aureus* has a special tropism for cartilages, and once in circulation, are very likely to anchor into the cartilage matrix. These bacteria can be transmitted from breeder parents, contaminated egg shells or hatchery sources, or enter via the respiratory system or gastro-intestinal tract.

How could probiotics have an impact on the incidence of lameness?

Enteric bacteria can translocate from the intestine and migrate into the systemic circulation. Once these bacteria enter the circulation, they can reach the capillaries that irrigate the bones. Probiotics theoretically might interfere with the development of osteomyelitis by attenuating intestinal populations of pathogenic bacteria, by improving gut health and gastrointestinal tract mucosal barrier, by reducing bacterial leakage (translocation) across the gut wall and by priming the immune system to better eliminate translocated bacteria. Intestinal protection by means of probiotic supplementation could lead to fewer bacteria reaching the articular surface, thereby reducing the incidence of BCO and subsequently lameness.

Evaluating Biomin® IMBO as a Prophylactic Treatment for Lameness by Using a Wire Flooring Model to Induce Lameness in Broilers

In order to study the development of lameness, a wire flooring model for inducing lameness in broilers was developed by a group of researchers under the direction of Prof. Wideman at the Department of Poultry Science, University of Arkansas, USA.

As the incidence of lameness is low in research flocks, the phenomenon has been difficult to study so far, which has hampered efforts to develop measures that may help producers. Growing broilers on wire flooring provides an excellent experimental model for reproducibly triggering significant levels of clinical lameness attributable to osteochondrosis and osteomyelitis of the proximal femur and tibia to enable statistically sound studies. Leg disorders and lameness are commonplace when birds are reared in cages with wire flooring due to high stocking densities and lack of exercise.
The results of a study to evaluate the effect of Biomin® IMBO on lameness were published in the April issue of Poultry Science, (R.F. Wideman *et al.*, "A wire-flooring model for inducing lameness in broilers: Evaluation of probiotics as a prophylactic treatment." Poult Sci 2012 91:870-883).

In this study, an experiment was carried out to evaluate the efficacy of the synbiotic Biomin® IMBO as a prophylactic feed additive for preventing the onset of lameness in broilers by using the wire flooring model for inducing lameness in broilers. Biomin® IMBO helps to establish, maintain and stabilize a beneficial and protective gut microflora. Infection resistance is improved through the combined effects of probiotics, prebiotics and defense strengthening substances. Immunological costs are saved, thereby increasing energy available for performance.

Trial design

Broiler chicks (Line G, males & females) from a commercial hatchery were placed at >60 birds per pen at 1 d of age (approximately 690 cm^2/chick). All chicks received standard hatchery vaccinations for Marek's disease, tenosynovitis, and infectious bursal disease virus. At 14 d of age the population was reduced to 55 of the largest, healthiest chicks per pen (approximately 900 cm^2/chick). The d 14 culling protocol was instituted because necropsies of runts during the first 10 d revealed macroscopic evidence of systemic bacterial infection including osteomyelitis. Feed and water were provided *ad libitum*. The control diet was a commercial 23 % crude protein corn and soybean-meal based chick starter (crumbles) formulated to meet or exceed minimum National Research Council (1994) standards for all ingredients.
Birds were randomly allocated to different experimental groups reared either on a wood shavings litter flooring (control) or wire flooring, and were fed the control feed alone or control feed mixed with Biomin® IMBO at a dosage of 0.5 kg/ton during the whole period.

Table 1 *- Different treatment groups reared on wood shavings litter or wire flooring and that were fed a control diet or the control diet mixed with the Biomin® IMBO*

Treatment	Group 1 Control	Group 2 Control	Group 3 Biomin® IMBO
Floor	wood shavings	wire flooring	wire flooring
Biomin® IMBO	-	-	0.5 kg/ton whole period

Lame birds were removed as soon as the onset of lameness was noticed, and were euthanized via CO_2 gas inhalation and necropsied. All survivors at d 56 were considered to be clinically healthy. Survivors were euthanized via CO_2 gas inhalation and necropsied to assess sub-clinical lesion incidences in the proximal heads of the femora and tibiae.

Necropsy Procedures

Euthanized birds were necropsied within 30 min *post-mortem*. Diagnostic categories:

- **Cull** = runts and moribund individuals that failed to thrive
- **UNK** = unknown cause of death
- **SDS** = sudden death syndrome (flipover, heart attacks)
- **PHS** = pulmonary hypertension syndrome (ascites)
- **KB** = kinky back or spondylolisthesis
- **TW** = twisted leg or slipped tendon (perosis, chondrodys trophy)
- **TD** = tibial dyschondroplasia;
- **LAME-UNK** = lameness for undetermined reasons
- **FHS** = proximal femoral head separation or epiphyseolysis
- **FHT** = proximal femoral head transitional degeneration
- **FHN** = proximal femoral head necrosis.

The total incidence of femoral lesions was calculated as:
Total Femur = (FHS + FHT + FHN)

The total incidence of lameness was calculated as:
Total Lame = (KB + TW + LAME-UNK + TD + FHS + FHT + FHN + THN)

The SigmaStat® ANOVA package (Jandel Scientific, 1994) was used to compare BW among experimental groups, treatments and genders. For comparisons of lesion incidences, the individual bird was used as the experimental unit, and the SigmaStat® Z-test procedure was used to compare proportions.

Results and Discussion

Table 1 illustrates the results from an experiment which was carried out to study the efficacy of Biomin® IMBO to reduce lameness in broilers. Adding Biomin® IMBO to the control feed beginning at 1 d of age reduced the total percentage of lameness for birds on wire flooring to a level similar to that of the wood shavings control group.

Table 2 *- Percentage of lameness incidence in broilers from lines G that were fed control broiler starter feed (Control feed) or the same feed containing 0.5 kg/ton Biomin® IMBO while being reared on wood shavings litter or wire flooring from 1 through 56 d of age*

Group	Floor	Feed	Total Lame
Group 1 Control	Wood shavings	Control feed	4 %[b]
Group 2 Control	Wire flooring	Control feed	15.5 %[a]
Group 3 Biomin® IMBO	Wire flooring	Control feed + Biomin® IMBO	**5 %[b]**

[a, b] Different superscripts denote a significant difference (P≤0.05) between the groups within a diagnostic category (Z-test).

Table 3 summarizes the leg lesion incidences by treatment and diagnostic category for birds that developed clinical lameness between 15 and 56 days of age. Lesion incidences did not differ by diagnostic category among the groups due to the low numbers of clinically lame individuals in the wood shaving control and Biomin® IMBO groups.

Table 3 *- Leg diagnosis incidences for broilers from Line G that developed clinical lameness while being reared on wood shavings litter or wire flooring, and that were fed a control diet or the control diet mixed with Biomin® IMBO*

Bone & Diagnosis	Floor Type and Diet Treatment		
	Group 1 Control Wood shavings	**Group 2 Control** Wire flooring	**Group 3 Biomin® IMBO** Wire flooring
FEMUR			
Normal	25 %	44.1 %	58.3 %
FHS	0 %	23.5 %	8.3 %
FHT	75 %	29.4 %	33.3 %
FHN	0 %	2.9 %	0 %
All Femur	75 %	55.9 %	41.7 %
TIBIA			
Normal	75 %	29.4 %	41.7 %
THN	25 %	70.6 %	58.3 %

The proximal femoral and tibial heads of both legs were evaluated and were diagnosed as being macroscopically normal (no apparent abnormalities) or as exhibiting femoral head separation (FHS), femoral head transitional degeneration (FHT), femoral head necrosis (FHN), or tibial head necrosis (THN)

All broilers that did not develop clinical lameness were necropsied on d 56 to evaluate the incidence of sub-clinical macroscopic lesions in proximal femoral and tibial heads (*Table 4*). Sub-clinical lesions were equally likely to develop in the left and right legs, and in males and females (not shown). With regards to the tibial head diagnostic categories for broilers that had not developed clinical lameness by d 56, the Biomin® IMBO group had the highest incidence of normal tibia (79.3%) and the lowest incidence of THN (20.7 %) when compared with both of the groups fed the control diet, regardless of floor type. For the femur, the Biomin® IMBO group elicited the lowest numerical level of FHT and significantly lower levels of THN when compared with the wood shaving control group and wire-control group. Accordingly, Biomin® IMBO appeared to have attenuated the sub-clinical development of severe lesion categories in the proximal femur and tibia heads of apparently healthy broilers on d 56. Biomin® IMBO may prevent or attenuate the progressive deterioration of sub-clinical femoral or tibial head lesions into the pathogen-associated osteomyelitis that causes terminal lameness in broilers.

Table 4 *- Leg diagnosis incidences for broilers from Line G that did not developed clinical lameness while being reared on wood shavings litter or wire flooring, and that were fed a control diet or the control diet mixed with Biomin® IMBO*

Bone & Diagnosis	Diet and Floor Treatment		
	Group 1 Control Wood shavings	**Group 2 Control** Wire flooring	**Group 3 Biomin® IMBO** Wire flooring
FEMUR			
Normal	27.8 %	30.9 %	37.9 %
FHS	31.5 %	41.4 %	41.9 %
FHT	38 %[a]	25.5 %[b]	19.7 %[b]
FHN	2.8 %	2.1 %	0.5 %
All Femur	72.2 %	69.1 %	62.1 %
TIBIA			
Normal	50.9 %[c]	67.6 %[b]	79.3 %[a]
THN	49.1 %[a]	32.4 %[b]	20.7 %[c]

[a,b,c] Different superscripts denote a significant difference ($P < 0.05$) between the groups within a diagnostic category (Z-test). Diagnostic categories include: Normal (no apparent abnormalities), femoral head separation (FHS), femoral head transitional degeneration (FHT), femoral head necrosis (FHN), and tibial head necrosis (THN)

Conclusion

The results of these studies demonstrate that the synbiotic Biomin® IMBO significantly reduced the incidence of clinical lameness in broilers grown on wire flooring. The most common cause of lameness in broilers, bacterial chondronecrosis with osteomyelitis (BCO), may be reduced by administering Biomin® IMBO prophylactically from the first day of rearing. Biomin® IMBO was shown to reduce the development of clinical lameness by interfering with bacterial translocation into sub-clinically damaged voids or clefts in the proximal femoral and tibial epiphyseal plates. These experiments indicate that bacterial translocation from the gastrointestinal tract is likely to be a significant route contributing to hematogenous infection.
The synbiotic Biomin® IMBO administered prophylactically from the first day of rearing can provide a plausible alternative to antibiotics for reducing the incidence of BCO.

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> IMPRESSUM

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