Monitoring of broiler intestinal health to improve performance

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Gut health is a crucial prerequisite for an economically viable broiler industry. The value of converting feed into meat in poultry production can be roughly calculated: 52 billion birds consuming each 4kg of feed requires 208 M metric ton of feed produced globally in the professional poultry industry.

Estimated is that on average, per 2.5kg live-weight-bird, about 10 €cents of production is lost by suboptimal coccidiosis control and a similar 10 €cents is lost by suboptimal bacterial enteritis control, together on average leading to over 10B € losses in the poultry industry. Obviously, as this is an average, some companies will have much lower and some much higher costs due to these two most important intestinal disorders.

In order to evaluate the level of control and to interpret the added value of additives, feed strategies and management procedures are important. Scoring broilers at different ages is a common procedure in order to evaluate coccidiosis levels since a widely accepted gross lesion scoring system has been introduced.

Recently, harmonised scoring procedure for bacterial enteritis has been proposed and is gaining popularity in order to have a more complete picture of gut health status of broiler flocks, in order to more objectively enhance modifications and improve technical thus financial performance of poultry operations.

Bacterial enteritis

Bacterial enteritis (sometimes called dysbacteriosis, small intestinal bacterial overgrowth –SIBO) is a poorly defined condition of the gastrointestinal tract occurring very frequently in broiler production in the EU since the ban on meat and bone meal and the ban on antibiotic growth promoters.

It is often confused with other conditions of the gut such as coccidiosis or necrotic enteritis and there is a need for more accurate diagnosis of this condition. Causes are multifactorial and poorly defined. Some very common etiologic factors are thought to be: raw feed ingredients which are poorly digestible (for instance wheat containing high levels of NSP) or poor absorption of nutrients present in the gut lumen (for instance after reduction of the physiological performance of the gut caused by viral or coccidial challenges).

Although the aetiology seems rather diverse and unspecified, it is hypothesised that, in hybrid broiler and turkey breeds, selected for maximal growth rate and high feed intake, abundance of non-absorbed nutrients (digested to a variable degree and with a varying absorbability), in absence of growth promoters with antibacterial properties, causes a chain of events that exacerbates the at least relative proliferation of some clusters of bacteria that leads to a reaction of the gut wall.

This reaction of the gut wall in its turn instigates a couple of microscopic and in some cases also macroscopic changes that, as in a vicious circle, will lead to poorer physiologic status of the gut, leading to poor digestive and absorptive functions of the gut.

Bacterial enteritis signs

On an epidemiologic level, feed consumption at flock level is very often one of the first signs. In most cases feed consumption will not decrease, but the expected average increase in feed consumption on a flock level is decreased or has levelled out.

Very frequently, water consumption will not be affected compared to normal levels in this stage, making the increased water/feed ratio as a precocious sign that farmers can use in order to ask for veterinary diagnosis.

One of the most visible consequences of the increased water/feed ratio will be wet litter, especially in seasons where the normal expulsion of water from the chicken house by ventilation is more costly (depending on humidity and outside temperatures) and the water, as a consequence, will need to be absorbed by the litter only.

The guts will be slightly irritated, resulting in more inflammation expressed microscopically by increased lymphocytic infiltration and lymphocyte aggregation and macroscopically by redness of the gut wall and very often a remarkable increase of the visibility of hyperaemic blood vessels on the serosal side of the gut wall.

Microscopically the gut probably reacts to the changes in microbiota causing physiologic stress to the gut, by producing more mucus and by harbouring an increased number of goblet cells. These microscopic findings will result macroscopically in sometimes more slimy and often watery gut contents, and in the second part of the jejuno-ileum and even rectum and excreted faeces to unusual high number of undigested feed particles.

Reduced tonus of the gut is seen macroscopically, microscopically linked with reduction in thickness of tunica muscularis. Overall gut wall elasticity, thickness and overall strength is reduced at necropsy (when only facing coccidiosis, very often the gut is also more fragile but more thick than normal guts) a higher degree of villus fusion and reduction of the length of the villi can be seen microscopically.This reduced tonus leads to a flaccid appearance of the edges of the dis-

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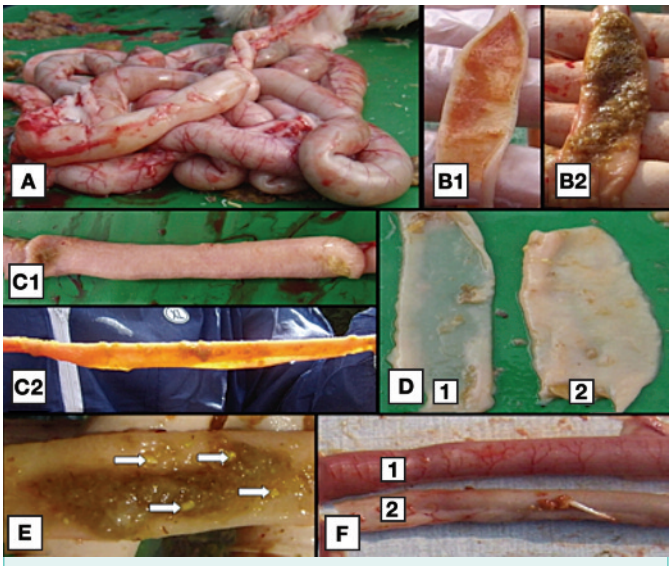

A. Overall gut ballooning.
B. Content of the intestinal tract.
1. Mucoid, orange intestinal content.
2. Foamy intestinal content.
C. Tonus of the intestinal tract.
1. Good tonus. 2. Lack of tonus.
D. Macroscopically visible thickness of the intestinal tract.
1. Macroscopically thin intestinal tract.
2. Intestinal tract with normal thickness.
E. Undigested particles in the colon (arrows).
F. Inflammation of the gut.
1. Inflammation. 2. No inflammation.

Fig. 1. Macroscopic dysbacteriosis score system parameters (De Gussem, M. (2010). Macroscopic scoring system for bacterial enteritis in broiler chickens and turkeys. In WVPA Meeting 01/04/2010. Merelbeke, Belgium).

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sected gut compared to normal guts where normal tonus causes the edges after dissecting the gut to fold back and causing the gut to be inverted with the mucosal side on the outside and the serosal side on the inside of the dissected gut section.

Another consequence is ballooning of the gut: some parts of the intestine will have a visibly larger diameter than other parts, containing more or less amounts of liquid, greasy, slimy and/or gaseous gut contents. Because the gut wall is thinner, the gut contents such as grain particles might become visible from the serosal side of the unopened, translucent gut.

By scoring, in a consistent and repeatable way, the macroscopic lesions related to bacterial enteritis in at least five birds per chicken flock a better understanding of the status of the broiler flock with regards to this very common condition is anticipated.

In its turn, a better understanding of the status of the flock will help the feed industry and the veterinarian of the flock to help find the underlying, typically multifactorial aetiology of bacterial enteritis. Five birds per flock is a standard number of birds culled for assessment of macroscopic lesions for coccidiosis, and in that sense, the bacterial enteritis lesion score system can be implemented in an economic and efficient way in existing diagnostic procedures by skilled veterinarians.

Scoring system

The scoring system proposed is performed on at least five birds taken ad random from the flock or experimental unit, considered to be representative.

The birds are freshly culled by trained personnel in a humane way causing minimal stress for the birds and with a method that can be applied in field conditions as well (for instance cervical dislocation).

Each bird will be scored from 0 to 10, with a total of 10 parameters being scored with 0 or 1 as described below.

- Ballooning of the gut: if there is ballooning of the gut, a score of one is given, if no ballooning, score remains zero.

- Significant redness of the serosal and/or mucosal side of the gut; and/or presence of abnormally dilated blood vessels on the serosal side of the gut, cranial from Meckel's diverticulum: if present score one is given, if absent a score of zero.

- A macroscopic visible and/or tangible reduction of the gut wall thickness, and/or translucent guts in combination with increased fragility of the gut cranial from Meckel's diverticulum: if present score one is given, if absent a score of zero.

- If, three seconds after dissecting the gut, the edges of the gut cranial from Meckel's diverticulum are flaccid, a score of 1 is given. If edges are folding back causing inversion of the gut wall, a score of zero is given.

- Abnormal appearance of the contents in the lumen of the gut (excessive slime, water, gas, greasy aspect or mixture of these) cranial from Meckel's diverticulum is scored as 1, normal contents will be scored as zero.

- Significant redness of the serosal and/or mucosal side of the gut; and/or presence of abnormally dilated blood vessels on the serosal side of the gut, caudal from Meckel's diverticulum: if present score one is given, if absent a score of zero.

- A macroscopic visible and/or tangible reduction of the gut wall thickness, and/or translucent guts in combination with increased fragility of the gut caudal from Meckel's diverticulum: if present score one is given, if absent a score of zero.

- If, three seconds after dissecting the gut, the edges of the gut caudal from Meckel's diverticulum are flaccid, a score of one is given. If edges are folding back causing inversion of the gut wall, a score of zero is given.

- Abnormal appearance of the contents in the lumen of the gut (excessive slime, water, gas, greasy aspect or mixture of these) caudal from Meckel's diverticulum is scored as one, normal contents will be scored as zero.

- Undigested feed particles caudal from ileo-caecal junction are scored as one, if absent a score of zero is given.

Maximal score per bird therefore is ten. All scores of birds from the same flock or experimental unit are added and divided by the number of birds scored in order to obtain the mean bacterial enteritis score for the flock or experimental unit.

Coccidiosis scoring system

Coccidiosis lesion scoring is an interpretation of infection pressure based on macroscopic visible lesions caused by Eimeria, usually following a scoring system from zero to four.

The individual scores for all the species are usually compiled for a certain number of birds (for example six) per flock resulting in a Total Mean Lesion Score (TMLS).

The method is extremely labour intensive, sometimes subjective and only reliable when performed by skilled people. The correlation between lesion scores and performance is believed to be stronger than with OPG but still there is a difficult appreciation of the level of lesions towards impact on performance, especially at subclinical levels.

A limitation is for instance the fact that E. mitis, although quite pathogenic, does not cause typical lesions and is mostly disregarded when using this method. Lesion scoring still remains the most frequently applied diagnostic method today.

The seven species of Eimeria infecting chickens are considered not equally important. Generally, it is agreed upon that from the species recognised in broiler chickens, the most pathogenic are E. acervulina, E. maxima and E. tenella.

The latter is, amongst broiler farmers, the best known. It infects the caeca and because of its deep development in the mucosa and subsequent wide-spread damage with distinct gross lesions and loss of blood in the faeces, it is easily recognised also by farmers.

On the other hand, when performing field necropsies on a larger scale, E. tenella appears to be the least prevalent of the three species mentioned.

Also, the damage is being limited to the caeca, relative less important parts of the gut with regard to digestion and absorption, thus effects on growth and feed conversion rate.

Diagnosis of clinical disease caused by E. tenella is quite easy and action (therapy on the short term, change of preventive means on the long term) can be swift.

These facts make its impact on the productivity of the broiler industry relatively limited compared to other species, although many broiler farmers associate coccidiosis only with caecal coccidiosis. This is a good example of perception not being in accordance with the facts. E. acervulina and E. maxima, both much more prevalent, are less perceived to be related with clinical coccidiosis in the field. E. acervulina is causing white lesions in duodenum and in heavier infections also more caudal, interfering even with the ability for E. maxima to develop. E. maxima causes petechiae in the midgut.

To assess the level of damage caused by these two species, lesion scoring can be performed. An important debate is still ongoing on what levels are to be considered clinical (and requiring treatment) and what levels are subclinical. Some consider lesions higher than 1.5 per species as indicative for clinical disease, and levels below as subclinical, not requiring treatment.

E. praecox and E. mitis are not scored for and are completely disregarded using the lesion scoring method, although both species are shown to be able to cause losses through an increased feed conversion rate and in the latter case even morbidity.

Moreover, it has been demonstrated there can be a poor relation between macroscopic and microscopic lesions, emphasising using macroscopic lesion scoring alone is not suitable to detect all economical relevant coccidiosis infections.

It is frequently disregarded that all macroscopic, but also microscopic lesions, in fact any infection of coccidia, requires an invasion and thus destruction of host cells.

This is both true when the parasitical life cycle can complete, but even so when an intervention of the immune system occurs.

In the latter case not only host cells are destroyed, but also the activation of the immune system requires use of nutrients that cannot be addressed to the conversion of nutrients into meat, the ultimate goal of broiler production.

As a consequence it is important to understand that any level of coccidiosis is causing a real, but difficult to quantify, loss in performance.

As coccidiosis is a disease that cannot currently be eradicated, the objective of coccidiosis prevention is finding the economical optimal balance between costs of diagnosis, prevention, treatment and development of host immunity while trying to keep the subclinical loss as low as possible.

It is clear that producers achieving a better balance will have a competitive advantage over other producers.

Gut health necropsy

Necropsy sessions are performed in cooperation with the pharmaceutical industry, with in-house veterinarians or independent specialists in a number of countries.

Basically, such systems consist of a planned, organised and benchmarked assessment of the lesion scores and gut health on a poultry complex (group of farms on the same anticoccidial and gut health program) basis.

A number of times per year and always at the same laboratory, preferably the same, well trained specialists assess a significant number of poultry houses, thus improving the reproducibility compared to a field lesion scoring session.

This methodology is suitable for assessing the overall efficacy of the anticoccidial program, enzyme choices, management, and other gut health improvement additives.

In order to make firmer conclusions, session data are compared with historical data and/or with industry averages. ■

References are available from the author on request