Intestinal health in young birds – securing a good start

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In modern poultry production hatchlings do not have the benefit of direct contact with their parents.

In nature, the environment in which the birds are hatched contains a large number of commensal micro-organisms derived from the faeces of the egg's guardians. These bacteria readily populate the bird's intestinal tract of the hatchlings assisting with the maturation of the immune system and with the protection against pathogens.

This article will focus on the importance of the early establishment of a commensal microflora in poultry. Several situations will be given to depict circumstances in which pathogenic bacteria can make their way through the system to gain access into the birds.

Artificial environment

In commercial poultry production birds hatched in the hatchery are exposed to an artificial environment. Lots of effort is placed in modern hatcheries to keep the environment with low numbers of pathogenic bacteria. However, this is not easy to achieve and it is not uncommon to find pathogenic salmonella, E. coli, streptococcus and proteus in commercial hatcheries. This is especially true if hygiene in the hatchery is not appropriate.

There are several sources for the mentioned bacteria to gain access to the hatchery. Among the obvious ones are visitors, rodents, flies and hatchery personnel.

Standard hatcheries normally have a well established procedure to designate 'clean' and 'dirty' areas. This is done to avoid cross contamination of incubators with bacteria that is constantly arriving in the new batches of eggs prior to their disinfection.

Segregation between 'clean' and 'dirty' areas in the hatchery is normally given by the circulation of the eggs in only one direction. In a well designed hatchery the air flow assists this process: the air should move from clean to dirty areas and never the other way around.

This simple measure prevents contaminated dust and airborne particles reaching the incubators. This gives place for a less obvious way in which pathogens can reach the clean areas, for example, air flow disturbances originated when doors are left intentionally open.

Even if excellent management and hygienic conditions are in place there is a high risk of incorporating pathogens that cannot be cleared from the eggs. This is the case of bacteria that can be harboured in the eggs. Through vertical transmission salmonella can colonise the avian ovary and contaminate egg yolks. In the oviduct salmonella is also able to penetrate the egg shell and gain access into the egg.

Since a high percentage of salmonella contaminated eggs are able to hatch, a wide dissemination of the bacteria occurs due to the ventilation system inside the incubators.

Actually, salmonella can stay years in hatcheries and elimination can be especially tedious since several serotypes of these bacteria can infect hatchery workers. If personal hygiene of the personnel is not adequate, salmonella could actually circulate back from humans to birds.

From the hatchery birds are transported to the poultry houses, a process that usually takes many hours. It is not uncommon that birds are placed 24 hours after hatch. Using denaturing gel electrophoresis it is possible to find bacterial communities in the intestines of one day old chicks.

These bacteria may be ingested during hatch or from the environment during pipping, processing, and transportation.

Ensuring chick comfort

Whatever the place these bacteria are coming from it is very unlikely that they will resemble the kind of bacteria that birds can acquire in nature starting from the pipping process. In several cases this is inevitable and our main objective should be to make these new born chicks feel as comfortable as possible.

In order to accomplish this, a good environment must be supplied to the chicks as soon as they are placed. A warm place, appropriate bedding, clean water and feed are the minimum essentials.

Throughout the world there are different practices to receive day old birds. In some countries it is common to give high doses of antibiotics to reduce intestinal pathogens that may have been acquired from the hatchery. This is mostly done in places

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where there is not an optimal communication between the poultry houses and the supplying hatchery. The problem of this practice is that it retards the establishment of a commensal and protective intestinal microflora. In other geographical locations birds are just received with a diet formulated with the best available raw materials.

Support the microflora

Whatever is the customary procedure to receive day old birds into their new environment it is always a good idea to support the development of a rapid commensal microflora. This is because pathogens and opportunistic bacteria can readily colonise naïve intestines due to the several factors that favour the development of any bacteria: space, nutrients, and lack of competitors.

Independent of the effort that we place on keeping pathogens away from our poultry houses there are many factors that need to be controlled simultaneously.

Mechanical vectors like visitors, cars, trucks, are always a threat for the biosecurity program. Biological vectors like flies, roaches, beetles and rodents are difficult to control and they are a known reservoir of pathogenic bacteria. In addition to these pests, wild birds should always be kept away from poultry houses and feed mills. If these

vectors can gain access to the poultry house or to the feed in the mill there is a risk of incorporating pathogens in the production system.

There is plenty of scientific evidence that currently supports the use of probiotic products in young birds. Nowadays, it is well established that a mixture of selected probiotic bacteria can protect the birds from pathogens. One of the functions of the intestinal microflora is to serve as a barrier against microbial pathogens. The mechanisms by which this barrier works remain largely unknown. However, there are modes of action that are becoming increasingly accepted to explain the efficacy of probiotics to decrease the invasiveness of pathogenic bacteria.

Several probiotics are able to produce molecules that are toxic for other bacteria.

The nature of these molecules is variable and they can have a wide or a narrow killing spectrum. Some bacteria produce short chain fatty acids, such as formic, acetic, propionic butyric and lactic acids, during the metabolism of carbohydrates.

These acids are toxic for several of the pathogens due to their role in decreasing luminal and also intracellular pH in the case of the Gram negative bacteria (short chain fatty acids can diffuse into the cytoplasm of Gram negative bacteria).

Other bacteria are able to produce hydrogen peroxide and also molecules with a narrow killing spectrum such as bacteriocins and bacteriocin-like substances.

Bacteriocins are produced by many genera of bacteria and they are toxic to other bacteria by several mechanism. Pore formation into the bacterial cell membrane and interference with the synthesis of bacterial molecules like RNA and DNA are two examples of their mechanisms of action.

Competitive exclusion or the competition of probiotic bacteria with pathogenic bacteria for attachment sites in the gastrointestinal epithelia has been claimed for many

years to explain the effects of probiotics against bacteria such as salmonella.

It seems that probiotic bacteria can effectively bind to some carbohydrates expressed by enterocytes that are used as receptor binding by pathogenic bacteria. In fact, there is evidence indicating that probiotics can not only mechanically exclude pathogens but they are also able to induce changes in the epithelial cells making them less susceptible to pathogenic invasion. This can be illustrated by the inhibition of pathogen attachment by increased production of mucins.

The production of mucin molecules MUC2 and MUC3 by the intestinal cell line HT-29 was increased after the co-incubation of this cell line with Lactobacillus plantarum.

The increased mucin reduced the attachment of enteropathogenic E. coli in vitro. There is another remarkable example leading to the conclusion that probiotics do not need to attach to the epithelia to physically block the attachment of pathogens.

Lactobacillus rhamnosus did not affect the number of attached enterohaemorrhagic E. coli into a colonic human cell line; however, the internalisation of the E. coli into the epithelial cells was greatly reduced by the interaction of the epithelial cell line with the lactobacillus strain.

Since this protective effect was only observed with live Lactobacillus it was hypothesised that the interaction of commensal bacteria and intestinal epithelium induces protective changes on the epithelial cells that interfere with the internalisation process of EHEC.

Desired probiotic features

There are several features that a probiotic should have to ensure the maximum benefit in poultry:

- The strains contained in a commercial probiotic should be the result of extensive screening based on their ability to inhibit pathogens (due to their production of acids, hydrogen peroxide or bacteriocins), capacity to adhere to epithelial cells, and safety for animals and humans.
- Probiotic strains should be derived from the same species of animals in which they will be used to ensure maximum compatibility between bacteria and host.
- Multi strain probiotics may be superior to single strain products because they may be able to exert their effect in several niches of the intestine. This is important due to the different biochemical properties found within the length of the gastrointestinal tract that may limit the development of foreign bacteria.
- A commercial probiotic should be tested against their ability to shed genes of antibiotic resistance.
- Inclusion of prebiotic substances (that serve as specific nutritional support) in the probiotic mixture may confer them additional advantage to multiply within the intestine. Biomin's PoultryStar is one of the probiotics offered in several markets that fulfils all the mentioned requirements.

In conclusion, the use of probiotics is recommended in young birds to protect their naïve intestine against pathogen colonisation. Probiotic supplementation should be done as early as possible. ■

References are available from the author on request. gino.lorenzoni@biomin.net