Effective antibiotic-free broiler breeder production

At the beginning of the last century, the discovery of antibiotics revolutionised modern medicine. Humans found a way to kill harmful bacteria and cure diseases responsible for thousands of deaths. It was soon applied to food animals too. The growth of the human population led to a significant intensification of food production, making the use of antimicrobials more frequent in both animals and humans, not always in a sustainable manner.

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Category	Product	Distribution	Pros	Cons
Probiotics	• Competitive exclusion complete flora • Live microbial supplement	Orally	• Gut health improvement • Performance improvement • Reduction in pathogenic bacteria colonisation • Immunity boost • Can be associated with prebiotics (i.e. synbiotics)	• Some are sensitive to water quality • No curative effect Strain selection is key
Prebiotics	• Non-starch polysaccharides	Orally	• Gut health improvement • Performance improvement • Immunity boost • Can be associated with probiotics (i.e. synbiotics)	• No curative effect
Phytogenics	• Essential oils, plant extract	Orally/ Spray	• Measurable in vitro efficacy • Potential curative effect	• Strong dependency on plant quality (affects the concentration in active substance) • Selected part (leaves, stem, whole plant) • Type of extraction
Organic acids	• Lactic, propionic, formic etc	Orally	• Measurable in vitro efficacy • Potential curative effect	• Lack of consistency • Potentially buffered in the digestive tract

Table 1. Short summary of alternatives for antibiotics (adapted from Gadde et al., 2017).

Through time, infections once easily cured became more difficult to treat, due to increasing antibiotic resistance (ABR). The mechanisms of ABR have been and still are the subject of extensive research all over the world. In that scope, the 'One Health' concept is being promoted by international human and animal health organisations.

Stakeholders, from regulation bodies to industry operators, have started taking major steps towards the monitoring and reduction of antibiotics usage. But more needs to be done on a global scale: antibiotics are still used in numerous countries as growth promoters, a perfect example of a short-term economic benefit with a long-term detrimental effect.

It is now widely accepted that antibiotics should only be used when animals are sick from bacteria, which can be achieved with a change of paradigm in the way broiler breeders (PS) are raised.

To achieve antibiotic-free production, the key prerequisite is to provide the most suitable environment to the birds. Gut health, environmental conditions and the promotion of birds' immunity are the pillars of the strategy.

Unlike broilers, the broiler breeder case has its specificities: Firstly, even though its economical purpose is not meat production (hence a less direct link to ABR as a risk in the human food chain), clonal transfer of specific resistant bacterial clones through the broiler production pyramid has been described and shows the importance of ABR control at all levels.

Secondly, raising broiler breeders involves numerous technical constraints which can unbalance the bird's homeostasis when not performed appropriately.

This article looks at the main points to consider.

Hygiene and husbandry good practice

The development of a disease in a bird is a result of the interaction between a pathogen (specific virulence or pathogenicity), the host (immunity, age, genetic make-up) and the environment. The ubiquitous nature of bacteria and the structure of poultry production make it easy to understand that a reduction in antibiotic use does not only depend on maintaining a proper hygiene at farm level.

Grandparent stock health, egg management, hatchery hygiene and control of the whole supply chain belong to the process as well.

It is not the purpose of this article to describe all the steps taken before delivery to ensure maximum PS chick quality, but all these steps have a significant impact on the future breeder's health and susceptibility to infection.

Assuming the above steps have been fulfilled, and a fit and healthy day-old PS chick is delivered to a thoroughly cleaned and disinfected house, the importance of proper brooding conditions in this critical phase cannot be emphasised enough. All suppliers have published extensive documentation on what ideal brooding conditions are for a specific cross or line, but they should always be adapted to the local conditions.

Focus should be placed on providing both quality and quantity to day-old chicks, the physiology of which is still under development for about a week after hatching (notably temperature regulation: accessible fresh feed and water, clean litter, pre-heated house, temperature and humidity control, light intensity, light uniformity and duration, ventilation and air flows are key factors in this respect.

If the above mentioned requirements are applicable to any type of poultry, broiler breeders do have specific constraints which can directly impact antibiotic use, as illustrated by the two examples below:

- Ad libitum feeding of a conventional broiler breeder will lead to very poor egg output (low peak, no persistence). Feed restriction is therefore mandatory in order to keep growth on a controlled path leading to a homogenous development of sexual maturity. Feed distribution becomes key for that purpose. When feed distribution is not optimal, due to lack of space, low distribution speed,

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inconsistent quantity or poor feed structure, there will be consequences on gut health and uniformity, opening the door to superinfections by opportunistic bacteria.

- Male management is another example. In case of artificial insemination, untrained staff can create injuries within the distal part of the oviduct. In case of natural mating, mixing mature-enough males to sexually receptive females is required to avoid behaviour issues leading to culls, scratches, over-mating, lameness, cellulitis and so on.

It appears that skilled staff, able to identify abnormal behaviours or environmental conditions, are a key asset in the strategy to reduce antibiotic use. Mastering global hygiene and proper breeding conditions better controls opportunistic superinfections.

Biosecurity

Biosecurity encompasses the steps taken in order to prevent a pathogen from entering the shed, from going out of a shed or from spreading to nearby sheds. It proceeds from a thorough analysis of the flows in and out of the farm, in order to identify the potential sources of contamination and implement the cheapest most efficient control procedure.

Potential sources include people, pests (rodents and mites), equipment, transportation, feed, water, litter and surrounding environment. Because it is adapted to each specific context, there is unfortunately no copy and paste miracle recipe. There are however three areas which should not be overlooked:

- **Laboratory reliability:**

To ensure the biosecurity plan is efficient, a regular monitoring of significant contaminants is needed (salmonella, mycoplasma, influenza, etc). This crucial step has to be performed in an accredited laboratory, where the tests sensitivity and specificity are up to standard and cross-contaminations are controlled. Regular laboratory tests with standardised samples should be regularly conducted to make sure there is no drift in the performance.

- **Staff training:**

Observance of biosecurity protocols is now being studied and shows that it is one of the main potential breaches.

- **Contingency plan:**

Biosecurity breaches do occur. The point is to be ready to deal with it, and be prepared: quarantined shed(s), dedicated staff, arranging feed delivery orders, etc.

Vaccination

Ensuring birds' optimal immunity is one of the keys to avoid the use of antibiotics. Let's not forget that viruses, on top of their own virulence, can serve as a door opener for opportunistic bacteria: avian metapneumovirus is an infamous example.

Vaccines will not usually prevent infections, but will dramatically reduce the clinical consequences, and generally reduce shedding. Vaccination against salmonella has been a key pillar of salmonella control in some European countries for example.

The development of autogenous vaccines has been a significant help in the management of specific pathogens. They consist of the development of a custom-made inactivated vaccine containing the specific strain or multiple strains of pathogens. There are different contexts in which autogenous vaccines can prove very useful:

- For bacteria against which cross-immunity between different strains (different serotypes for instance) is not protective enough, like E. coli.
- When commercial vaccines show inconsistent results or are not available.
- When high antimicrobial resistance is observed.
- When the same pathogen is found flock after flock.

Last but not least, vaccine failure should be thoroughly investigated, from delivery cold chain to vaccine storage, preparation and vaccination procedure, including the way animals are held during the process.

Systematic blood sampling at around 20 weeks to measure antibody titres is imperative to make sure birds are thoroughly protected and that the rearing farm staff know how to perform the job correctly.

Staff awareness

Previously we have emphasised the importance of empowering the farm managers on the fundamental physiological and technical requirements of broiler breeders. A key parameter, called observance, describes the probability of the actual implementation of rules and procedures.

The drivers to obtain observance have been studied mostly in the marketing or medical field, but also in poultry biosecurity. Observance depends on education, experience, motivation and personality traits.

Modern poultry companies have to invest in improving communication and training, in order to make sure procedures are properly applied.

Alternatives to antibiotics

Many well-written reviews can be found to list products that partially or totally mimic that of antibiotics. Table 1 is a non-exhaustive list of available alternatives. The majority of them are distributed orally, which emphasises the importance of gut health management for the success of an antibiotic-free strategy.

Phytogenic products can also be administered by spray, to specifically target respiratory stress. There is a certain unanimity to admit that even though efficiency has been proven in vitro, it lacks consistency when used in vivo in field conditions.

Future alternatives include bacteriophage therapy, which are viruses targeting specific species, strains or serotypes of bacteria. Though the efficiency is widely documented, the spectrum is very narrow, which is also why it is extremely safe on the microbiota.

Conclusion

An antibiotic-free strategy can only be successful if good husbandry, hygiene and biosecurity practices are implemented by skilled staff.

Alternatives exist, and many have a preventive effect rather than a curative one, reinforcing the importance of providing a proper environment.

At the broiler breeder level, the task is complicated by the inherent stress imposed on the bird due to specific physiological and technical constraints: feed restriction, male to female behaviour and lifespan to name a few.

The misuse of antibiotics can lead to the development of resistant bacteria impairing the success of sick poultry treatments. On a larger scale, antibiotic resistance is now considered as one of the major threats to human health. The trend is inevitable: the poultry industry and the whole food animal industry in general have to find ways to reduce and better use antibiotics.

The global demand for 'free of' markets is on the rise, and pushes the industry to adapt. Several countries have identified an increased risk in imported broilers or broiler meat compared to locally produced products.

It is only with an integrated approach involving all stakeholders and policy makers that a reasonable objective can be set in order to tackle the threat globally. ■

References are available from the author on request