The first 21 days are critical for developing a mature gut microbiota

Today's production landscape is highly influenced by government regulation and consumer pressure, both of which increasingly demand the reduction or elimination of antibiotics. The removal of this line of defence has opened the door to rising and unpredictable pathogen challenges that can lead to poor flock performance and livability.

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The energy that birds directed toward growth in the past must now be used to maintain health and overcome disease challenges. For this reason, producers must find ways to help their birds win the battle of the gut against non-beneficial bacteria and thereby release their energy to focus on growth.

The role of genetic selection

While this situation is significant in itself, it is compounded by the effect of an accelerated production lifecycle driven by the demand for rapidly grown protein.

The modern broiler increases its bodyweight by 25% overnight and by 5,000% at five weeks of age. Genetic selection has increased production efficiency, but research has shown a correlation with increased risk for negative immune performance in these animals.

One study showed that mortality at 42 days was four times higher in a 1991 commercial broiler strain when compared to a randomly bred baseline from 1957; 9.7% mortality vs 2.2% respectively. The same study showed higher mortality in birds selected for high bodyweight as compared to those with low feed conversion; 7.4% vs 2.0% respectively. In this case, mortality was largely caused by infectious diseases and heart and circulation problems.

Nutrient allocation and availability is a key consideration in this study. A population that is genetically driven towards high production allocates a higher proportion of resources to that trait, leaving fewer resources to respond adequately to other demands. In addition to the increased risk for behavioural, physiological and immunological problems, faster growth rates means birds have little time for gut maturation.

Lifelong impact of early gut development

As a bird's largest immune organ, a well-developed gut microstructure is essential for the lifelong absorptive capacity – and therefore the productivity – of the animal. This is largely impacted by the availability of proper nutrition at an early age. Ensuring access to food and water within 6-10 hours of hatching will aid in microvilli development, which impacts future absorptive capacity.

Conversely, poor diet and a challenging environment in the first few weeks can cause negative effects later on in production. The microbiota can take several weeks to develop fully, making the first 21 days a critical time for gut development and bird performance.

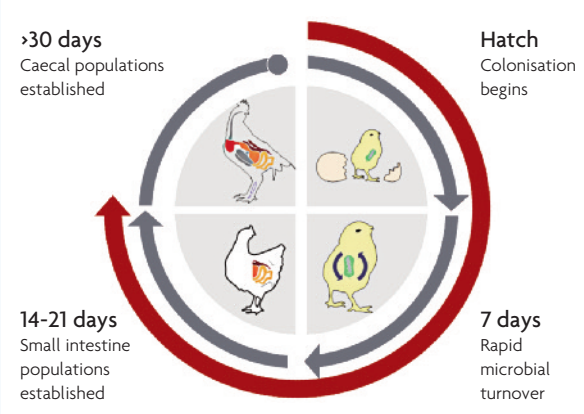

Fig. 1. Process of gut development in broiler chickens.

Beneficial bacteria in the first 21 days

In addition to the physiological changes of the gut structure in the first 21 days, there are also rapid changes in the bird's microbiota, which plays a critical role in bird health and productivity.

The microbiota, or micro-organisms residing in the gastrointestinal tract, works to inhibit colonisation of potential pathogens, supports immune development, and provides nutrients to the host.

However, chicks do not hatch with an established microbiota, its establishment takes time; a process known as microbial succession.

At hatch, bacteria begin to colonise the gastrointestinal tract, but the process can be greatly influenced by conditions in the hatchery as well as the process of transport and handling. By day seven, the intestinal bacteria population has grown 10-fold and around 21 days, the microbial population in the small intestine is largely established (Fig. 1). The microbiota in the distal gut takes more time to develop due to its complexity.

The mature broiler gut can host over 700 species of bacteria, many essential for health, but during microbial succession the predominant populations will change with age. For example, the beneficial bacteria lactobacilli is one of the final major colonisers, particularly in the small intestine (Fig. 2). Just as the bird's gut is a hospitable environment for these beneficial bacteria, it is also attractive to potentially non-beneficial bacteria. Birds are challenged immediately post-hatch with a variety of micro-organisms which can have a negative effect on the bird, such as Escherichia coli (E. coli), Clostridium perfringens (C. perfringens) Enterococcus cecorum (E. cecorum) and many more. Production conditions can affect birds' susceptibility to these micro-organisms.

Optimising gut health with probiotics

The key to production success is the rapid development of a healthy and mature microbiota. Producers must find ways to

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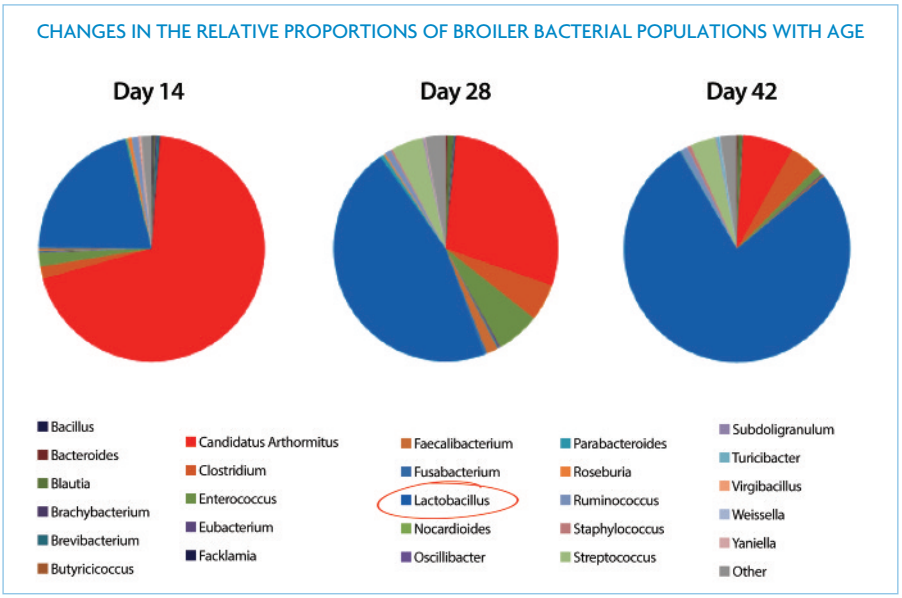
balance productivity with animal health and welfare by helping birds win the battle of the gut against non-beneficial bacteria and thereby enable their use of energy to grow.

Research has shown that feeding probiotics from day one promotes the quick establishment of a positive microbiota and guards against colonisation by coliforms, such as E. coli, that may have a negative impact on performance in growing animals.

However, not all probiotic strains defend birds in the same way. There are three strains of Bacillus, which have been isolated in the chicken gut itself, that act as a shield by preventing harmful pathogens from adhering to the cell wall in the gut. They strengthen the gut structure, slow the growth of non-beneficial bacteria, and encourage the growth of beneficial bacteria.

By accelerating the natural gut maturation process and delivering a more mature gut by 21 days of age, these three strains of Bacillus allow the broiler to gain maximum benefit from a mature gut for a longer period in the production lifecycle.

Fig. 2. Genus-level snapshot of the microbiota of the small intestine in broiler chickens at 14, 28 and 42 days (Neumann et al, 2011).



Overcoming production challenges

The vital role gut development plays on bird health and growth potential is clear. With all the challenges producers face – from less than optimal production conditions and the removal of antibiotics, to the impact of genetic selection on bird health and growth – giving birds a healthy start with probiotics has emerged as a good practice.

Aiding development of the microbiota in the first 21 days is an effective approach to enhance both production and animal welfare. ■

References are available from the author on request