Salmonella in layers – a more realistic approach to zero tolerance

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A recent paper by Richard K. Gast et al has been extremely useful in understanding how feed additives can counter the threat of salmonellosis even though they have no direct effect on rodent, insect or environmental contamination on the farm.

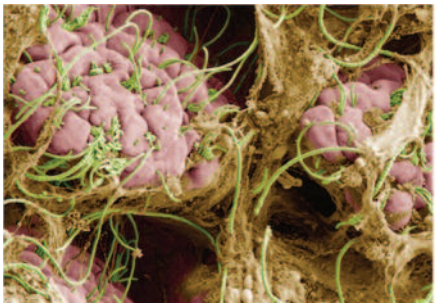
All animals rely on commensal microflora in the gut for both maturation and function of the mucosal immune system. Under intensive growing conditions, such as a commercial farm, the growth and development of these commensal microflora can be compromised. This is partially due to a fast passage of digesta through the gut. Problems also occur because of the existence of an inhibitory elevated pH as a result of alkaline minerals such as calcium salts being fed at high inclusions in the ration to maintain egg quality and bone strength.

Healthier microflora

By using protected acids in the gut it is possible to shift the bacterial populations towards a more acidophilic range so that we can promote a healthier commensal microflora. The complex nature of this commensal microflora is only now being unravelled with the discovery of segmented filamentous bacteria. This perhaps explains the inconsistent results found with many probiotic or competitive exclusion systems.

In any animal, the immune system needs to recognise antigens from potential pathogens and respond to them. However there are antigens present from the very high numbers of other bacteria in the gut and from the food consumed. Because the commensal bacteria are not simply passive passengers in the intestine, but are crucial to its function, the immune system needs to ignore some antigens and respond to others.

The role played by the commensal bacteria is vital to the host metabolism. These bacteria provide enzymes for digestion, they ferment normally indigestible nutrients, they synthesise vitamins and break down feed



Salmonella bacteria (scanning electron micrograph taken by Alice Liang, NYU and Doug Wei, Carl Zeiss; artificial colouring by Eric Roth, NYU).

derived toxins and potential carcinogens. They also have a role in the physiology of the intestine and help with host immunity.

The simplest mechanism by which commensal bacteria control potential pathogens is by changing the gut environment (often by producing agents like lactic acid) and by competitively excluding pathogens.

Recently, it has been reported that segmented filamentous bacteria are capable of specifically inducing Th17 cells in the gut of mice and this was the first example of how commensal bacteria can skew the mucosal effector T cell balance to enhance the immune fitness of the host. This natural immunity has many advantages compared with the potential side effects of uncontrolled antibiotic usage.

This recent work shows that innate immunity in layers can slowly eliminate salmonella from the gut provided the challenge from the environment is not too large.

In the report it was shown that birds orally gavaged with 10^4 cfu salmonella recovered from the challenge in four weeks. However birds challenged at higher levels such as 10^6 or 10^8 never managed to completely eliminate the salmonella from their gut. A reduced salmonella challenge from feed and faeces means that any challenge from other sources is unlikely to overpower the innate immunity of the birds.

In a commercial layer operation the frequency of salmonella shedding in the faeces and the design of the housing will have a direct impact on the exposure of the birds to salmonella. It is therefore vital that salmonella shedding be reduced.

This latest work clearly shows that a zero tolerance approach to salmonella is not essential. This would be an impossible goal as salmonella will be present as a result of insects, mites, water or staff.

Many potential salmonella sources are non-feed related, however by using a protected acid the salmonella challenge from the feed is minimised.

Protected acids play a direct role in reducing pathogen colonisation in the gut, thereby improving faecal quality. Protected acids use carriers to provide the ideal conditions for colonisation by commensal bacteria. This in-gut activity is not possible with liquid acids, acid salts, or unprotected acids.

By identifying the link between these findings and protected acids, there is now a real possibility that specific commensal-host interactions can be targeted to directly impact gut health in a therapeutic manner.

Impact of antibiotics

The use of prophylactic doses of antibiotics impacts on both pathogen and commensal colonisation and can only damage the natural immunity of the bird. Constant usage of antibiotics will also increase the risk of antibiotic resistance developing in the bird. The use of non-selective agents such as aldehydes in the gut will prevent commensal bacteria from functioning correctly to protect the host against pathogens.

Reduced numbers of commensal bacteria would be unable to occupy all the ecological niches in the gut or be able to effectively compete with pathogens for nutrients.

The benefits of acid applications are even more important when natural acid secretions in the gut have been neutralised by the addition of calcium salts, especially in layers and breeder feeds. It was no surprise that the salmonella scare began in eggs.

The more neutral to alkaline conditions found in layer intestines give pathogens an advantage so that they can soon dominate. If protected acids are used to provide acidic platforms then the balance and innate immunity of the gut will be restored. ■

References are available from the author on request