Salmonella management is very much an ongoing challenge

Though no-one likes to talk about it, despite all our available tools, salmonella is still a challenge to the poultry industry. The routes of transmission of salmonella have been very well described, but nonetheless it remains impossible to produce 100% salmonella-free poultry products. Slow release acids and functional flavours have the potential to be useful in this situation.

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They have the added benefit of not harming beneficial bacteria, which can offer some protection against salmonella introduced to the poultry. It is unlikely salmonella will be fully eradicated from poultry, but with using external and internal biosecurity the zoonotic risk can be greatly reduced.

When talking to the poultry industry no-one ever has salmonella: not the feed mill, nor the breeder farms, nor the production birds. But even so, positive birds are often found at slaughter.

So, salmonella is not something talked about, but its management is very much an ongoing challenge.

The European Commission RASFF – the rapid alert system for food and feed – already lists 19 cases from seven European Union countries of salmonella in poultry products by the time of writing (March 2020).

Nearly one in three foodborne outbreaks in the EU in 2018 were caused by salmonella.

This is one of the findings of the annual report on trends and sources of zoonoses published in December 2019 by the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC).

In 2019, 1,581 salmonella outbreaks were mainly linked to eggs. Therefore, it stands to reason that salmonella is by no means gone, and control measures have not only to be maintained, but also to be reviewed to ensure that poultry poses as low a zoonosis risk from salmonella as possible.

Routes of transmission

Like many poultry diseases wild birds can be vectors of salmonella. With the presence of other birds, 24 hour availability of feed and year-round warm temperatures, poultry houses are very attractive to wild birds.

The same applies to rodents, which are equally drawn to poultry houses. While these are well known threats, the farm cat, dog, even insects and humans that enter the house all pose a risk of introducing salmonella to a flock. Feed is another well described risk for salmonella introduction to flocks.

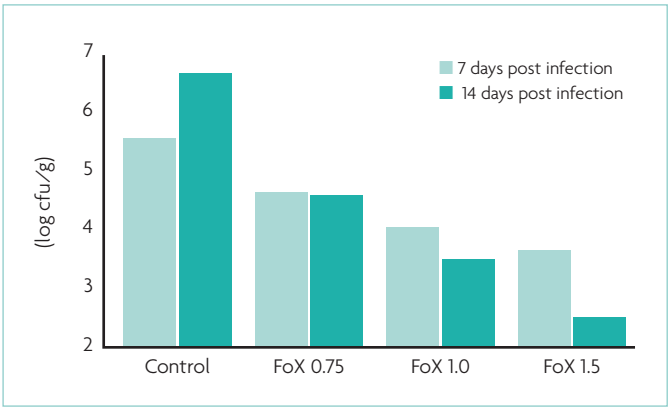
Every step from risky raw materials such as protein meals, through manufacture and transport to storage on farm needs to be monitored. It is particularly crucial to understand that while there is a range of options to kill salmonella, not all offer residual protection from recontamination of the feed.

By contrast, millSMART, as an example for feed processing and feed safety, is a cost-effective programme with the application of Sal CURB, an antimicrobial surfactant solution containing a synergistic mixture of organic acids, surfactants, co-surfactants and a corrosion inhibitor, to kill salmonella, and prevent recontamination in both raw materials and finished feed.

Buildings themselves can pose a salmonella risk, as dry salmonella in a dormant status in the form of biofilms have been shown to remain potentially infectious for as long as two years.

Ultimately birds themselves can carry salmonella, every pullet or day-old chick or hatching egg introduced can carry salmonella.

Fig. 1. Caecal salmonella load in artificially infected broilers.



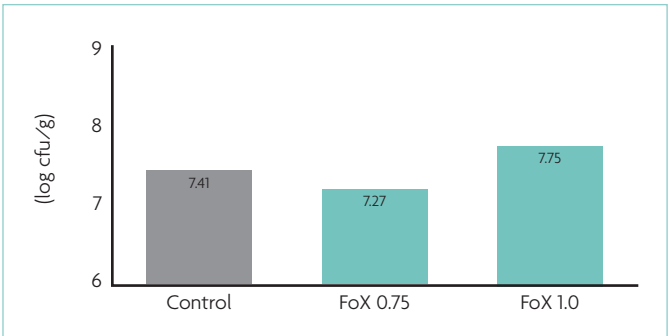


Fig. 2. Count of lactobacillus in the caecum contents at 40 days of age (log cfu/g).

The breeder flocks

As breeder flocks come into contact with every farm, they are normally the best managed with all available controls such as both live and killed vaccines, high biosecurity and the most strict feed hygiene procedures.

The focus on breeders is clean eggs, meaning eggs with only a commensal or beneficial microbial load without any pathogens (and without salmonella specifically). Eggs are furthermore treated externally to keep the introduction of salmonella and other potential pathogens into the incubators and through hatching as low as possible.

But is that sufficient? After all, hygiene is only affecting the shell, and anything present already in the egg cannot be touched.

A great focus should be on managing the entire microbiome of the breeder. Because not only potential pathogens are introduced via the egg and eggshell, but also the first beneficial microbiota that colonise the gastrointestinal tract and protect against salmonella colonisation.

Rather than looking only into ways to minimise salmonella, a more holistic approach involves maintaining or improving beneficial microbiota, alongside controlling potential pathogens.

Improving shell quality in broiler breeders to assure the best quality of day-old chicks can further improve day-old chick quality.

Tools to manage the health of the breeders

There is a range of standards like pest control, biosecurity on farm and feed level and vaccinations to maintain the health of the breeders. However, there are also tools to maintain the biosecurity at intestinal level, because salmonella loads in the intestinal tract directly affect

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the risk of transmission to the hatching egg.

Organic acids are frequently used via water and feed to control salmonella in both water lines and feed. After neutralisation at the start of the small intestine, they do however lose efficacy and salmonella can grow unaffected by them.

A controlled trial by Kemin showed the potential for organic acids beyond the acidification of feed into the small intestine.

A total of 80 all-female commercial Ross 308 birds were placed in isolators and at day seven inoculated with 10^6 CFU of a field strain of Salmonella enteritidis.

The diet of three groups contained a slow release blend of organic acids (formic, citric) and encapsulated essential oils. It was included at 0.75, 1.0 and 1.5kg/ton respectively. Control birds received no supplementation (Fig. 1).

A smaller independent in-vivo broiler trial with a different objective verified whether Lactobacilli are affected by the treatment (Fig. 2)

Both trials clearly showed it is possible to significantly manage salmonella even at the gut level of the birds, without risking harm to the beneficial flora.

It can be a challenge to keep wild birds away from domestic poultry.

This clearly differentiates this approach from legal antibiotics that are still used in salmonella management.

Contamination of the eggshell from outside can pose a significant risk to hatchery biosecurity and for the emerging chicks.

It has been shown that not all broiler breeder eggs have fully competent membranes making the risk of contamination of the inside of the egg more serious if micro-cracks are present as well.

A healthy breeder that makes good quality shells (low incidence of microcracks, clean eggs) can further reduce the salmonella risk of day-old chicks.

Several studies have shown probiotic strains, for example Bacillus subtilis ATCC PTA-6737, to be both helpful for eggshell quality and egg cleanliness.

External and internal biosecurity

Biosecurity is usually defined as 'procedures or measures designed to protect the population against harmful biological or biochemical substances'.

Of course, the population in the case of poultry is the flock. But no biosecurity, even in parent stock, will provide 100% salmonella protection.

There will always be salmonella in poultry, but to limit the risk as much as possible it makes sense to think about a second level of biosecurity. Inside the chicken, we must focus on trying to limit salmonella colonisation as much as possible.

Conclusion

In conclusion, the salmonella risk to consumers from poultry has dropped significantly in the last two years, but as producers of products ultimately meant for human consumption we are clearly required to minimise all opportunities for salmonella contamination as much as possible. ■

References are available from the author on request