Strategies to control enteric bacterial diseases during fattening

Weaning is the most critical phase for piglets. The stress due to separation of piglets from their mother, the new environment, the mix of different litters, and the change in diet from milk to a solid feed, is usually associated with low and variable feed intake that results in a transient growth check. In addition, maternal antibody levels, mainly responsible for the protection of piglets against infections during early life, are significantly reduced.

by Cinta Sol & Mónica Puyalto, Norel SA, Spain. www.norel.net

There are also marked changes in small intestine histology and biochemistry, such as villous atrophy and crypt hyperplasia, which cause decreased digestive and absorptive capacity and contribute to post-weaning diarrhoea, impaired immune re-activity, altered composition of the intestinal microbiota and ultimately result in animals more vulnerable to infections, reduced weight gain and more days to achieve market weight.

Strategies: feed additives

Since the ban on the use of antibiotics as growth promoters in 2006, due to concerns about feed safety and the development of antibiotic-resistant pathogens, animal nutritionists are highly interested in active and non-medicated nutritional alternatives for optimising the weaning transition and also minimising enteric diseases in the fattening period.

Several alternatives have been proposed: enzymes, probiotics, prebiotics, phytogenic agents, and organic acids, some of which, alone or in combination, clearly contribute to animal health, mostly through acidification of the gastrointestinal tract (GIT) environment and/or control of potentially-pathogenic bacteria.

Among the alternatives mentioned above, an organic acid such as sodium butyrate has been widely described in the literature.

Sodium butyrate is involved in the positive effects on the intestinal epithelium; improves performance parameters, beneficial bacterial populations, and reduces the colonisation of harmful bacteria in the digestive tract of broilers, and reduces the colonisation of salmonella in chickens.

In pigs, however, the results are more variable. In a study published by Casanova-Higes and co-workers in 2017, the dietary administration of protected sodium butyrate during the whole fattening period was able to significantly reduce the seroprevalence and shedding of salmonella, which could reflect a positive effect on the control of salmonella at the end of this period.

Sodium butyrate can be protected with different kinds of fat to allow the product to be released along the gastrointestinal tract.

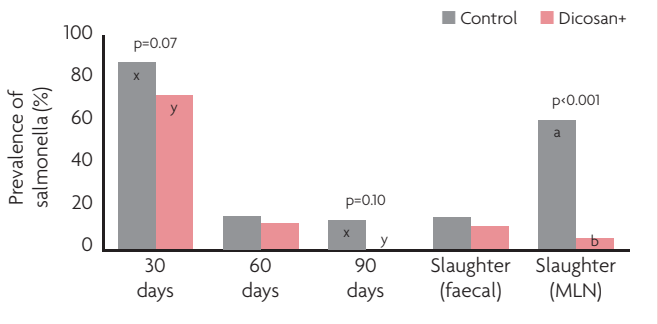
In particular, protection with medium-chain fatty acids (MCFAs) appears to provide a synergistic effect with sodium butyrate. MCFA are used not only as a physical fat protection but also as a functional protection due to the properties of those fatty acids.

MCFAs are a family of saturated fatty acids present in coconut oil that includes caproic acid (C6:0), caprylic acid (C8:0), capric acid (C10:0) and lauric acid (C12:0).

Lauric acid is the primary fatty acid of coconut oil, which is present at approximately 45-53% of the overall fatty acid composition. Lauric acid has the strongest antimicrobial activity among all saturated fatty acids against Gram-positive bacteria and some viruses and fungi.

This combination of sodium butyrate protected with MCFA could be a promising approach to control enteric bacterial diseases during the whole rearing period of pigs.

Fig. 1. Salmonella prevalence in faecal samples and mesenteric lymph nodes (MLN). Fisher exact test, one-tailed (Casanova-Higes et al., 2018).



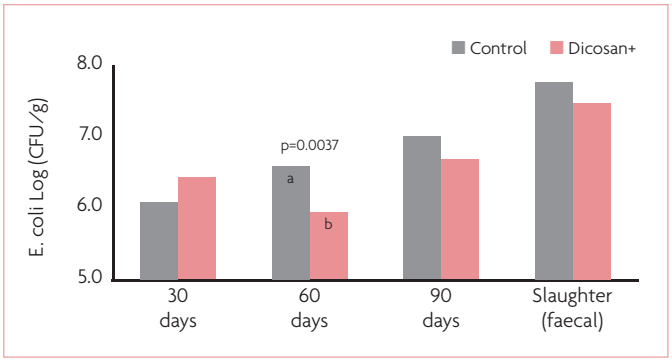


Fig. 2. Mean log (CFU/g) per group and sampling for E. coli enumeration. t-test.

Case study

A study was carried out on a small (eight pens, ≈110 pigs) commercial salmonella-infected fattening unit.

Feed with sodium butyrate protected with MCFA (Dicosan+, Norel SA, Spain) was administered to animals from four randomly selected pens (treatment group, DIC). Pigs from the remaining four pens were fed with the same regular diet but without the addition of the Dicosan+ (control group, CON).

When pigs entered the fattening unit they were in-feed treated with amoxicillin and Zn oxide after which the treatment with Dicosan+ was initiated (3.25 months). The dose used along the whole trial was 3kg of Dicosan+/t of feed.

Measurements

Bacteriology from individual faecal samples and mesenteric lymph nodes (MLN) was performed for salmonella.

For E. coli enumeration in faeces, faecal samples from 10 pigs per group were used. For ETEC detection, it was carried on the same samples used for E. coli enumeration and was based on the detection in those samples of genes encoding for the following four virulence factors that characterise ETEC: F4 fimbriae and enterotoxins heat-stable (STa and STb) and heat-labile (LT).

Results

Salmonella bacteriology on faecal and MLN samples for the DIC and CON are presented in Fig. 1. Both groups showed a large proportion of shedders on the first sampling, but the proportion of shedders decreased significantly in the following samplings for both groups.

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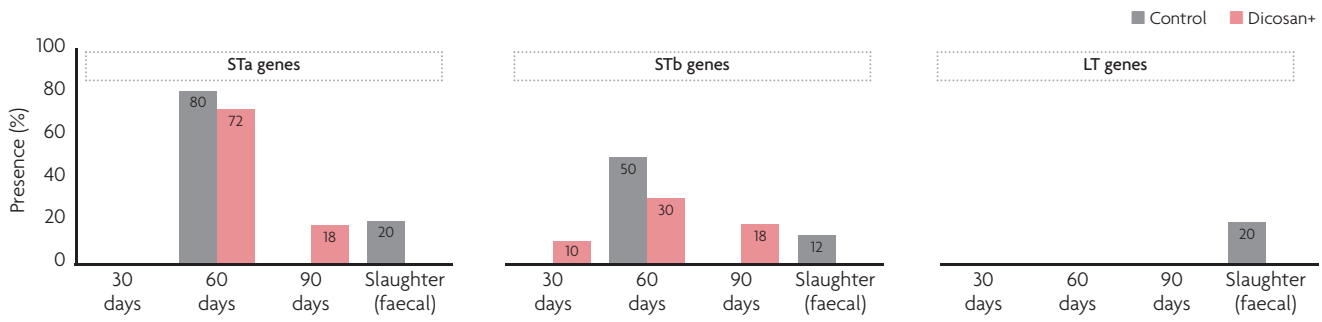

Fig. 3. Proportion of pig faecal samples positive to the presence of STa, STb and LT genes of enterotoxigenic E. coli.

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Overall, there was a tendency after 30 days of fattening in the proportion of shedders (87.5% vs 72%; P=0.07, for CON and DIC, respectively). There was also a trend at 90 days (14.2% vs 0%; P=0.10, for CON and DIC, respectively).

Finally, at slaughter, the proportion of infected pigs (MLN+) was significantly higher for CON compared to DIC (61% vs 4%; P<0.001).

Fig. 2 shows the mean log (CFU/g) per group and sampling for E. coli enumeration. Although a slight decrease in CFU was observed in DIC compared to CON, differences were not significant, except for the sampling at 60 days on the fattening unit.

Overall, a significant increase in CFU was found for both groups along the trial, with higher mean CFU/g as pigs approached slaughter. This increase from day 30 to slaughter was somewhat higher in the CON (1.69 logs for CON vs 1.05 logs for DIC).

Fig. 3 shows the proportion of samples in each group presenting STa, STb, LT genes. No positive pigs for F4 fimbriae gene were found at any of the sampling times. STa was found in 23.75% of the samples (12.5% in CON and 11.25% in DIC), STb 15% (7.75% in CON and 7.25% in DIC), and LT in only 2.5% in CON group.

STa and STb were found most frequently on day 60 of fattening, while LT was only found at slaughter.

Overall, no significant differences were observed on the number of samples presenting any of the genes analysed between both groups at any of the four sampling times.

Discussion and conclusions

The percentage of pigs shedding salmonella on the first sampling seemed to be related to an early exposure of the farm unit to salmonella. Further samplings showed a very low level of shedding in both groups although always somewhat lower for DIC, sometimes reaching the statistical significance.

The reduction of shedding along the fattening period in both groups may be related to the adaptation of the pigs to the unit environment. Given the large number of pigs shedding salmonella on day 30, a large number of infected (MLN+) pigs at slaughter were expected for both groups. Although this was true for CON, as 60.7% of pigs resulted infected, it was not observed in DIC (4.3%). This finding suggest a protective effect of Dicosan+ against salmonella infection despite the high level of exposure to salmonella of these pigs at the beginning of the fattening period.

Regarding enumeration of E. coli, a lower number of E. coli were observed in the DIC compared to the CON treatment, but this difference was not large enough to be considered either statistically or biologically significant, except for the second sampling (60 days).

Commensal E. coli and some other pathogenic E. coli (Shiga-toxin producing E. coli) have been described as acid-resistant bacteria, more resistant to low pH than salmonella, which may explain the lack of differences between groups.

Although ETEC is a common disease-producing agent in young piglets, it can also be harboured by older pigs that may disseminate it. In this study some ETEC genes were detected from faecal samples from these pigs, and especially frequent were the genes encoding for STa and STb toxins. Despite that, no significant differences were observed in the proportion of these genes between both groups. A slightly higher overall proportion of STa and STb positive samples were found in the control group.

In summary, a beneficial effect has been found after administering Dicosan+ to pigs. A significant reduction in the number of infected pigs was observed in pigs under treatment. Therefore, the use of Dicosan+ at 3kg/t would appear to be be a potential strategy to reduce salmonella shedding and infection in slaughter pigs when used during the whole fattening period.

However, no effects were observed on the overall loads of E. coli and on the presence of ETEC. ■

References are available from the author on request