Efficacy of protected sodium butyrate for controlling salmonellosis

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Salmonella cause more than 40,000 reported infections per year in the US, and this is estimated to be only 1/40 of the real cases figure. The CDC blames this bacteria for 4,000 infections, 40 hospitalisations and more than one death per day, only in the US.

In Europe, 280 cases are reported every day; EFSA has estimated that the overall economic burden of human salmonellosis could be as high as €3 billion a year. Being one of the zoonosis with higher incidence, there are many players that are doing an extra effort to reduce the possibility of transmission into the food chain from the farm (and even eradicate it) because of the regulation or because the producer wants to deliver a high quality final product (safer).

Nowadays reduction of salmonella prevalence is a challenge for the pig sector. Any producer needs to control this parameter if he wants to be competitive in the current market.

However, it is not easy to control the infection in the farm, because there are many factors associated with swine salmonella dispersion once the bacterium is present in the barn.

The producers must apply very strict biosafety and hygiene measures, and must manage the animals appropriately, and even so, the infection sometimes cannot be avoided. There are certain complementary activities, like including certain additives (acidifiers, prebiotics, probiotics, etc) in the feed, that may help to reduce the risk of infection, as they work inside the animal, where they can reduce the virulence of the bacteria or even destroy them.

Organic acids and their salts

Organic acids and their salts have been used to control enteropathogenic agents for years, and there are many publications where it is demonstrated that their direct addition in the feed or water help to reduce the number of enterobacteria in the gastrointestinal tract. The anti-salmonella effect of the acids, mainly short chain fatty acids, has been evaluated in several experimental studies and field trials in swine and the results are, in general, favourable.

An important limitation of these organic acids and their salts, when controlling salmonella, is that the active principle is released and quickly absorbed or used in the proximal part of the gastrointestinal tract (duodenum). Therefore its potential activity against salmonella is lost or minimised further in the GIT, where usually salmonella adheres and colonises the tissues of the animal. This limitation can be overcome using protected salts, with encapsulation or other protection technologies, that prevent its fast dissociation and total absorption in the first part of the small intestine, ensuring active principle in the distal part of the GIT.

Several scientific studies have demonstrated butyric acid efficacy, particularly protected sodium salt of butyric acid, to control salmonella in poultry and swine. These studies suggest that these additives have bactericidal-bacteriostatic effect in proximal part of gastrointestinal tract and also are able to reduce the salmonella pathogenesis throughout down-regulating the expression of some virulence genes related to invasion of enterocytes.

The following trial was carried out by Animal Nutrition and Welfare Service (SNIBA) of Autonomous University of Barcelona, to determine the effect of a protected form of sodium butyrate (Gustor BP70, Norel SA, Spain) in front of a

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Fig. 1. Villus height and crypt depth on day four post-infection in piglets challenged orally with Salmonella typhimurium. NS: No significant difference (P>0.1). T: Trend towards significance (P<0.1). *: Significant difference (P<0.05).

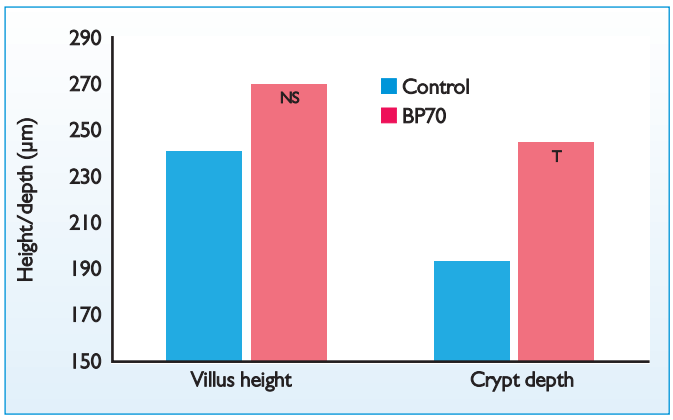
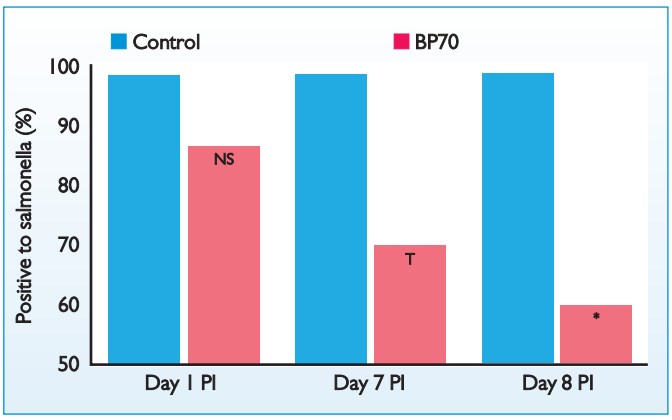


Fig. 2. Percentage of animals positive to salmonella, during the first week after oral challenge. The results on day one and seven post-inoculation (PI) are microbiological analysis of faecal samples. The results on day eight PI are analysis of colonic digesta samples. Samples were collected from the same animals along different sampling days (the heaviest per pen) (n=8).



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Salmonella typhimurium oral challenge in piglets.

Gustor BP70 is an ingredient comprising 70% of sodium butyrate protected with 30% vegetable fat. This vegetable fat allows a gradual liberation of the sodium butyrate along the gastrointestinal tract.

Different commercial and scientific trials with poultry have demonstrated its efficacy against salmonella infection. The purpose of the following study was to asses if GUSTOR BP70 could have the same effect in swine.

Material and methods

The test was performed with 48 piglets (28 days old) (Large White x Landrace). Their initial body weight was 8.2 ± 0.79kg. All animals were confirmed to be sero-negatives to salmonella (ELISA Herdcheck Salmonella, IDEXXI Lab) and showed absence of the bacteria in faeces when they arrived at the experimental farm. The piglets were randomised in 16 pens (three piglets per pen) and two experimental groups:

- Control group (C), 24 piglets fed ad libitum with basal diet without additives.
- Sodium butyrate protected (Gustor BP70), 24 piglets fed ad libitum with basal diet and 3kg Gustor BP70/t of feed.

After a week of adaptation, the animals were orally inoculated with Salmonella typhimurium (1 x 10^8 CFU/animal). After inoculation, a veterinarian performed a daily clinic examination to all piglets, and measured feed intake and weight during 16 days. Faeces consistency was evaluated as well, as was rectal temperature (24 and 72 hours post inoculation-PI) and faecal excretion of salmonella at one and seven days PI. One animal per pen was euthanised at day four and eight PI to evaluate immune response (TNF- and Pig-Map, plasmatic), histomorphological changes in ileon and salmonella presence in colon (only at day eight PI).

The productive results, faecal consistency, rectal temperature and plasmatic parameters were analysed with ANOVA. The salmonella qualitative results in faeces and colonic content were compared with a Fisher test. In both cases, data were analysed by SAS vs. 9.2. Significant differences were marked at $P< 0.05$.

Results

During the monitoring period, no significant differences were observed in productive parameters or in faecal consistency, rectal temperature or inflammatory indicators ($P>0.05$). Neither were there significant differences in villi height; however, there was a tendency to show deeper crypts in the animals that received the protected sodium butyrate on day four post infection ($P<0.1$) (Fig. 1).

Fig. 2 shows faecal shedding of salmonella on day one and seven PI and salmonella presence in the colon on day eight PI. The samples were collected from the same animal along the different days (the heaviest of the pen). The number of positive animals to salmonella in faeces tended to reduce in the group of animals receiving the protected sodium butyrate at day seven PI ($P<0.1$) and this reduction reached statistical significance in the colon at day eight PI ($P<0.05$).

Conclusions

The results demonstrate that the addition of the protected form of sodium butyrate with vegetable fat GUSTOR BP70 at 3kg/t of feed reduce the colonisation and excretion of salmonella in piglets orally challenged with a pathogenic strain of the bacterium.

These results encourage the industry to confirm the efficiency of this tool as a preventive of salmonella infections in field trials. A reduction in salmonella presence in the gastrointestinal tract of animals arriving at the slaughterhouse can contribute to the reduction of carcase contamination risk during the evisceration process. ■

References are available from the authors on request