

# Enterisol Salmonella T/C® Vaccine Reduces the Clinical Impact and Colonization of Monophasic *Salmonella enterica* serovar I 4,[5],12:i:-

Fernando Leite<sup>1</sup>; Paulo Arruda<sup>2</sup>; Dianna Jordan<sup>1</sup>; Shawn Bearson<sup>3</sup>, PhD

<sup>1</sup>Boehringer Ingelheim Animal Health USA Inc., Duluth, Georgia; <sup>2</sup>VRI-AMVC, Ames, Iowa; <sup>3</sup>ARS-USDA, Ames, Iowa

## Background

The monophasic *Salmonella* I 4,[5],12:i:- serovar is now the most common *Salmonella* serovar identified in U.S. swine clinical cases. This serovar has also become one of the most common to cause human foodborne salmonellosis and is also the most frequent multidrug resistant (MDR; resistance to  $\geq 3$  antimicrobial classes) serovar in the U.S. Given the significance of this serotype to both swine health and food safety, the objective of our study was to evaluate the impact of the Enterisol Salmonella T/C® vaccine on reducing clinical parameters as well as colonization of swine with MDR *Salmonella* I 4,[5],12:i:-.

## Materials and Methods

A randomized, blinded, controlled study was conducted with three different treatment groups consisting of 20 pigs, blocked for the effects of litter, sex and weight. The treatment groups were: 1) non-vaccinated/non-challenged (NVNC); 2) non-vaccinated/challenged (NVC); 3) vaccinated with Enterisol Salmonella T/C®/challenged (EVC). Animals were intranasally challenged four weeks post vaccination at approximately 7 weeks of age with a dose of  $2 \times 10^9$  *Salmonella* I 4,[5],12:i:- strain SX 240. This is a multidrug resistant strain of *Salmonella* I 4,[5],12:i:- that was associated with a human foodborne outbreak from pork in the U.S. and that also causes clinical disease in pigs. Animals were monitored daily for clinical signs and evaluated for weight gain for a period of 14 days following challenge. Fecal samples were collected at 0, 2, 3, 7, 10 and 14 days post inoculation (dpi). All pigs were euthanized at 14 dpi; macroscopic enteric lesions were evaluated, and tissues representing preferential sites of *Salmonella* colonization were collected for *Salmonella* culture and quantification including ileal cecal lymph node (ICLN), ileal Peyer's patch (IPP), cecal tissue (CT) and cecal contents (CC).

## Results

When evaluating clinical parameters, NVC animals had a significant increase in the incidence of diarrhea (59/254), compared to NVNC pigs (0/280) and EVC pigs (12/280) ( $p < 0.05$ ). This represented a significant increase of both the duration of diarrhea as well as the number of pigs with diarrhea. One pig in the NVC group died following challenge and had intestinal lesions compatible with enterocolitis due to salmonellosis. At 14 days post challenge, four pigs in the NVC group had intestinal lesions, while no pigs had lesions in the NVNC and EVC groups ( $p < 0.05$ ). Average daily weight gain was significantly decreased in the NVC group (1.197 lbs) compared to NVNC group (1.693 lbs) and EVC group (1.536 lbs) ( $p < 0.05$ ). The difference in ADG equated to vaccinates being 4.7 lbs heavier than non-vaccinates over the challenge period.

Fecal shedding of *Salmonella* peaked in both challenged groups at 2 dpi with shedding levels of 6.3 and 5.6  $\log_{10}$  cfu/gram (g) in the NVC and EVC groups, respectively. Compared to the NVC group, a significant ( $p < 0.05$ ) reduction of shedding in the EVC group was observed beginning at 3 dpi and at each subsequent timepoint following challenge. At 14 dpi, the NVC group shed on average 3.5  $\log_{10}$  cfu/g while the EVC group shed on average 1.4  $\log_{10}$  cfu/g

( $p < 0.05$ ). Vaccination also led to a significant ( $p < 0.05$ ) reduction in the colonization level of all measured tissues; this reduction ranged from 1.18  $\log_{10}$  cfu/g in ICLN to 2.33  $\log_{10}$  cfu/g in IPP. Furthermore, a significant ( $p < 0.05$ ) decline in the number of EVC pigs colonized by MDR *Salmonella* I 4,[5],12:i:- was detected in the ICLN, IPP, and CT (35%, 65% and 40% reduction, respectively) compared to the NVC pigs.

### **Conclusions**

Enterisol Salmonella T/C® is a vaccine that contains live, attenuated strains of both Choleraesuis and Typhimurium (the latter is a serovar of the same serogroup as *S.* I 4,[5],12:i:-). In our study, vaccinated pigs had significantly reduced diarrhea and improved weight gain following challenge with MDR *Salmonella* I 4,[5],12:i:-, parameters which are important to swine health and production. Given that higher *Salmonella* colonization levels have been associated with a greater likelihood of carcass contamination and that lymph nodes can directly contaminate final pork product, it is also noteworthy that Enterisol Salmonella T/C® significantly reduced both the level and number of colonized pigs. These results suggest that the Enterisol Salmonella T/C® vaccine can be a pre-harvest tool to improve food safety and diminish MDR *Salmonella* I 4,[5],12:i:- in swine.