Development of a *Clostridium perfringens* type A / C toxoid vaccine for sows to protect piglets against the Necrotic Enteritis and negative effects of an infection with *Clostridium perfringens* type A

S. Springer, J. Finzel, G. Hagemann, V. Florian, N. Hitzel, Th. Vissiennon and H.-J. Selbitz
IDT Biologika GmbH, Animal Health, Research and Development
D–06855 Dessau-Rosslau, Germany, P.O. Box 400214
Tierpathologie Dr. Th. Vissiennon, Leipzig
contact: sven.springer@idt-biologika.de

Introduction

***Clostridium perfringens* type C** (CpC) causes necrotising enteritis (NE) in suckling piglets, which can result in a high mortality. However, ***C. perfringens* type A** (CpA) belongs to the normal intestinal microbiota of piglets within the first days of life. Strains producing high quantities of toxins (α- und β2-toxin) though are able to cause diarrhea in suckling piglets under unfavourable conditions such as agalactia or multiple infections. In order to control the disease a CpA toxoid vaccine (ENTEROPORC A) was developed, a CpA / CpC toxoid vaccine (ENTEROPORC AC) is currently under development. Aim of the studies was to examine the efficacy of the vaccines by using intoxication models under laboratory conditions.

Material und Methods

Sows were vaccinated with the respective vaccine batches (ENTEROPORC A, ENTEROPORC AC) five and two weeks prior to farrowing. The corresponding control groups received physiologic saline solution at the same times. Prior to the 1st and 2nd vaccination blood samples and at the time of farrowing blood samples and colostrum samples were taken from each sow. Sera and colostrum samples were analysed for antibodies against α, β1 and β2 toxins by ELISA technique (Springer et al., 2012). For the evaluation of the efficacy two piglets of each litter were challenged with a sterile supernatant of a heterologous CpA resp. CpC strain i.p. on day 1 after farrowing. After the CpA challenge the clinical symptoms were evaluated by a score and the mortality was determined. After the CpC challenge the mortality and the number of runts were determined.

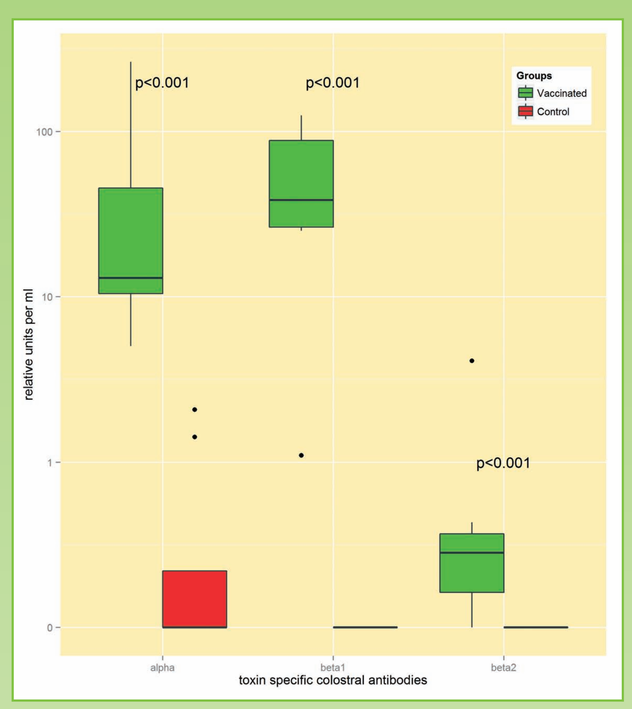

Figure 1:
Results of the formation of antibodies against the α-, β1- and β2 toxin in colostrum in gilts after being vaccinated with ENTEROPORC AC (green box) in comparison with the control group (red box).

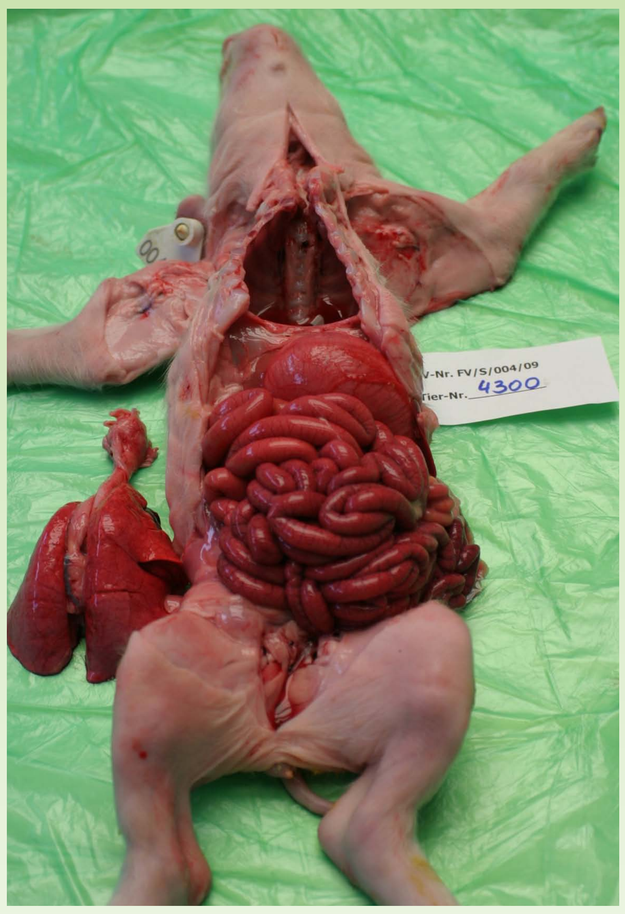

Figure 2: Haemorrhagic necrotising enteritis after i.p. application of β1 toxin containing supernatant of a heterologous CpC strain

Table 1:
Results of the clinical score (mean and SD) and the mortality after vaccination with ENTEROPORC A and i.p. challenge of the piglets with the CpA supernatant

Group	N (sows)	N (piglets)	Mean Score± SD	Dead piglets
Vaccinated	8	16	0 [a]	0
Placebo	8	16	2.81 ± 2.01	1 (6.25%)

[a] $p < 0.001$ (Mann- Whitney U test, one tailed)#1

Table 2:
Results of the mortality and number of runts after vaccination with ENTEROPORC AC and i.p. challenge of the piglets with the CpC supernatant

Group	N (sows)	N (piglets)	Dead piglets	Runts
Vaccinated	7	14	2 (14.3%)[a]	0
Placebo	7	14	11 (78.6%)	1 (7.1 %)

[a] $p < 0.011$ (Fischer's exact test, one tailed)

Results

All sows reacted with a significant rise in antibodies (Mann Whitney U test, one tailed, $p<0.05$) according to the vaccination against α- and β2-toxin (ENTEROPORC A) resp. α-, β1- and β2-toxin (ENTEROPORC AC) in the sera (at the time of farrowing) and in the colostrum (Fig. 1). After challenge with the CpA supernatant animals of the unvaccinated group partially became severely ill. Vaccinated animals (ENTEROPORC A) did not become ill (Tab. 1). The differences (score) between both groups were significant. After i.p. challenge with the CpC supernatant 78.6 % of the animals of the control group died (Tab. 2 and Fig. 2), 7.1 % showed a reduced development (runts). 14.3 % of the animals of the vaccinated group died, runts did not occur (Tab. 2). The differences in mortality were significant. The main histological lesions were coagulation necrosis of the villi, luminal necrosis and villous hyperemia in the jejunum (Fig. 3).

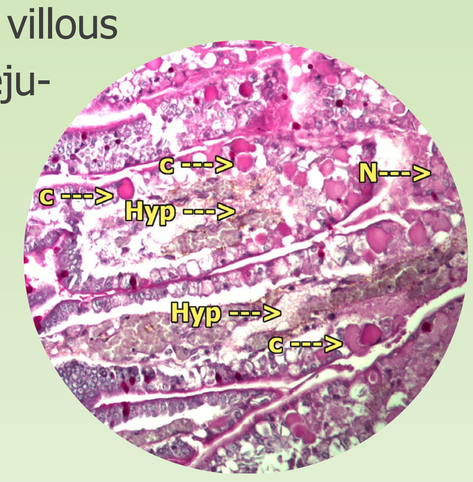

Figure 3: Marked coagulation necrosis, luminal necrosis , C= coagulation necrosis, hyp = hyperemia, N = necrosis, PAS stain, Obj. 25)

Conclusion

The vaccination with ENTEROPORC A resulted in the development of antibodies against α- und β2-toxin in the serum and colostrum and reduced significantly the morbidity after i.p. challenge with a CpA supernatant. The vaccination with ENTEROPORC AC led to the development of antibodies against α-, β1- und β2-toxin and significantly reduced mortality. For future trials it is planned to test the efficacy under field conditions.

References

Springer S, Finzel J, Florian V, Schoepe H, Woitow G and Selbitz H J (2012): Vorkommen und Bekämpfung des *Clostridium-perfringens*-Typ-A-assoziierten Durchfalls der Saugferkel unterbesonderer Berücksichtigung der Immunprophylaxe. Tierärztliche Praxis, 40 (G), 375–382