

Prevention of Oedema Disease in Weaned Piglets by Vaccination

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Abstract

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In order to prove the effect of vaccination against postweaning oedema disease, a trial was performed in a large Croatian pig production unit, with high prevalence of postweaning oedema disease. The trial animals were either vaccinated (group one, $n = 275$) with a VT2e-toxoid vaccine at 1 week of age (with 12.5 μg inactivated VT2e toxin per pig), and at 3 weeks of age (with 25 μg inactivated VT2e toxin), or were placebo treated (group two, $n = 274$). Postweaning performance of piglets and serological status against VT2e toxin were evaluated.

Vaccination significantly ($p < 0.05$) affected nursery weight gains (group 1: 302 ± 32 g; group 2: 276 ± 42 g). Mortality revealed significant ($p < 0.01$) differences between the vaccinated (group 1: 0.5%) and non-vaccinated pigs (group 2: 7.9%); fattening weight gain did not differ significantly ($p > 0.05$) between the groups (group 1: 741 ± 42 g vs. group 2: 706 ± 44 g). There was a significant rise of serological OD values due to vaccination in the vaccinated animals ($p < 0.01$).

Swine, Escherichia coli, weaning, mortality, weight gain

Weaning has been recognised as one of the most stressful challenges of the piglet's life (Shanks 1938). Postweaning *Escherichia (E.) coli*-caused problems can be subcategorised into postweaning diarrhoea (PWD), oedema disease (ED), postweaning wasting (PWW) and haemorrhagic gastroenteritis (HGE) (Bölskei et al. 1995). Oedema disease has often been caused by haemolytic F18 pilus positive *E. coli* O139 that produce verotoxin 2e (VT2e, Moon et al. 1999). Verotoxigenic *E. coli* colonise the intestine via F18 pilus (Wilson and Francis 1986). A VT2e-toxoid vaccine was found to be effective against ED (Awad Masalmeh et al. 1989). The objective of the present study was to determine the effect of a VT2e-toxoid vaccine against ED under field conditions.

Materials and Methods

A trial was performed in the large Croatian pig production unit, with high losses due to postweaning ED. *E. coli* were serotyped for O139 by slide-agglutination tests in Vet Invest Zagreb (Croatia). Analysis of the isolates was performed in Vet Invest Zagreb (Croatia) by multiplex PCR assay for detecting genes for Shiga-like toxin type II and fimbrial adhesins F18 ab, ac according to Bosworth and Casey (1997). Amplified products were electrophoresed in 2% agarose gel, stained with ethidium bromide, and examined under ultraviolet illumination. DNA fragment lengths were verified by a digested λ -DNA standard run simultaneously. Control for DNA reference strains was included in each reaction. Test sensitivity (Se) was 95.2%; specificity (Sp) 90.5%. Seropositivity was monitored by an indirect ELISA that was used to detect specific anti-VT2e antibodies in serum obtained every sampling time from the same animals (30 pigs [identified by ear tags] in each group). VT2e-toxoid in pH 9.0 carbonate buffer was applied directly to ELISA plates at 4 °C overnight. The plates were incubated with 0.05% Tween 20, 1% bovine serum albumin in PSB-T-BSA for 1 hour. Serum samples were applied in 1:200 dilutions in PSB. Antibodies were detected with peroxidase-conjugated rabbit anti-swine immunoglobulins in PSB-T-BSA. Further processing took place according to Johansen et al. (1997). Colour was allowed to develop for 20 min. Optical density (OD) was measured at 490 nm minus 650 nm by dual wavelength endpoints. The effect of vaccination on the serum level of VT2e-specific antibodies was assessed by the rise in optical density (OD) values. An experimental toxoid vaccine was produced as described by MacLeod and Gyles (1991) and Johansen et al. (1997).

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Two randomised blind parallel treatment groups of piglets (weaning age 28 days) were formed. The animals were treated in consent with animal care regulations of Croatia and Switzerland.

Group 1, G1 (n = 275) piglets were intramuscularly vaccinated at 1 week of age with 12.5 µg and at 3 weeks of age with 25 µg of inactivated VT2e toxin.

Group 2, G2 (n = 274) piglets were given placebo.

Average daily nursery weight gain during 4 weeks after weaning (NADG), nursery mortality due to ED (EDNM), fattening weight gain until slaughter (FADG) and serological response to vaccination were evaluated.

GLMM (general linear mathematical model) and REML (reference manual) procedures of the statistical package of Genstat 5, Oxford, Clarendon and Fisher's exact test were used to analyse data. For time aspects (such as the exact age of the piglets at the time of vaccination) and proportion of piglets dying for ED a logistic regression model was used. For ADG from weaning to the end of the nursery period a linear regression model was used. The effect of the sow (and the interaction between treatment and sow) and the effect of initial weight were included as random components, but had no significant influence on nursery weight gain (NADG), mortality due to ED (EDNM) and fattening weight gain (FADG). Weight gain in the finisher period was analysed by the model including weight at last weighing, treatment effect, age of the animal, the effect of age and the effect of weight at weaning, and the effect of group. The change in OD-values from first vaccination to the end of the nursery period was analysed by paired *t*-test.

Results and Discussion

Vaccination significantly ($P < 0.05$) affected NADG (G1: 302 ± 32 g; G2: 276 ± 42 g); mortality revealed significant ($P < 0.01$) differences between the vaccinated (G1: 0.5%) and non-vaccinated pigs (G2: 7.9%); FADG did not differ significantly ($p > 0.05$) between the groups (G1: 741 ± 42 g vs. G2: 706 ± 44 g) (Table 1). There was a significant rise of serological OD values due to vaccination in G1 ($p < 0.01$) (Table 2). The control pigs seropositivity shows the infectious pressure due to VT2e bearing *E. coli* in this unit. There was no effect of vaccination on growth performance in the fattening period. This indicates that pigs whose growth rates are suppressed during the postweaning period are able to recover and gain satisfactorily during the fattening period.

Table one
The effect of vaccination on nursery weight gain, mortality, fattening weight gain in a large pig production unit

Group	n	NADG g	EDNM %	FADG g
1	275	302 ± 32a	0.5A	741 ± 42ns
2	274	276 ± 42b	7.9B	706 ± 4ns

Table 2
The effect of vaccination on VT2e specific antibodies (OD) in a large pig production unit

Group	n	T 1	T 2	T 3	T 4
1	275	0.22 ± 0.01A	1.11 ± 0.01B	1.72 ± 0.01B	0.75B ± 0.01A
2	274	0.21 ± 0.02	0.14 ± 0.01a	0.35b ± 0.01	0.28b ± 0.01

Legend (Table 1 and 2)

NADG:	average daily nursery weight gain	ns:	non significant
EDNM:	nursery mortality due to ED	Test (T) 1:	before first vaccination
FADG:	fattening weight gain until slaughter	T 2:	at weaning (28 days of age)
OD:	optical density	T 3:	at the end of nursery period (from weaning to an age of 8 weeks)
a, b:	difference is significant ($p < 0.05$)	T 4:	at an age of 4 month
A, B:	difference is significant ($p < 0.01$)		

In the present study we decided to define “death caused by oedema disease” only cases with growth of haemolytic *E. coli* O139 bearing pilus F18 and revealing the for ED typical gross pathological changes.

The present results are consistent with the findings of Awad Masalmeh et al. (1988), Bosworth et al. (1996), Johansen et al. (1997), and Ken and Bilkei (2003) and indicate that vaccination with purified VT2e-toxoid can successfully prevent ED caused piglet losses under field conditions in weaned pigs.

Prevence edémové choroby vakcinací odstavených selat

K prokázání účinku vakcinace proti edémové chorobě po odstavu byl proveden pokus ve velkém chorvatském chovu prasat s vysokou prevalencí této nemoci. Pokusná selata byla buď vakcinována (skupina 1, $n = 275$) VT2e-toxoid vakcínou týden po narození (12.5 μg inaktivovaného VT2e toxinu), tři týdny po narození (25 μg inaktivovaného VT2e toxinu), či jim bylo podáno placebo (skupina 2, $n = 274$). Byl sledován přírůstek selat a provedeno sérologické vyšetření protilátek proti VT2e toxinu.

Vakcinace signifikantně ($p < 0.05$) zvýšila přírůstky (skupina 1: 302 ± 32 g; skupina 2: 276 ± 42 g); signifikantní byl rozdíl v mortalitě ($p < 0.01$) mezi vakcinovanými (skupina 1: 0,5%) a nevakcinovanými prasaty (skupina 2: 7,9%); váha po výkrmu se mezi skupinami signifikantně nelišila ($p > 0,05$), (skupina 1: 741 ± 42 g proti skupině 2: 706 ± 44 g). U vakcinovaných prasat nastal signifikantní nárůst ($p < 0,01$) optické density séra.

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