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Influence of four commercial porcine circovirus type 2 (PCV2) vaccines on the improvement of production parameters in pigs with maternally derived antibodies

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ABSTRACT

Anti-PCV2 antibodies in serum, viremia and production parameters (average daily weight gain [ADWG] and mortality) were assessed in piglets immunized with four commercial PCV2 vaccines in the presence of high levels of maternally derived antibodies (MDA). A total of 217 sows were vaccinated (V) at 7 and 4 weeks before farrowing with an inactivated PCV2 vaccine. All piglets derived from these sows (n=2215) were divided into five groups and 3-week-old piglets were injected with one of four different vaccines (A-D): V sows-VA piglets (n=437), V sows-VB piglets (n=424), V sows-VC piglets (n=432) and V sows-VD piglets (n=417). A control group of non-vaccinated piglets (V-NV, n=426) received phosphate-buffered saline (PBS). Sows (n=39) received PBS (non-vaccinated group). The ADWG of vaccinated piglets (V-VA, V-VB, V-VC and V-VD) ranging from 661 to 669 g/day were significantly higher than the control group (V-NV, 630 g/day), but differences in ADWG between vaccinated groups were not statistically significant. An overall mortality ranging from 7.23% to 9.20% was observed in vaccinated piglets (V-VA, V-VB, V-VC and V-VD) compared with the control group (V-NV, 20.02%). The number of genomic copies of PCV2 in serum for the control group were significantly higher than those of the four vaccinated groups at 10, 15, and 22 weeks of age. Vaccination increased serum antibodies in sows 3- to 4-fold; PCV2-specific antibody titers in sera from piglets were very similar to those of their sows. The antibody titers in vaccinated piglets and V-NV group decreased gradually about 3-fold until the week 10. In the presence of high MDA levels, piglets immunized with four commercial PCV2 vaccines showed a significantly reduction of PCV2 infected pigs, viral load, number of PCV2-sero positive pigs and mortality rate as well as significantly higher ADWG than those of the V-NV group.

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1. Introduction

Porcine circovirus type 2 (PCV2) is recognized as the causative agent of several clinical diseases and syndromes, collectively known as porcine circovirus-associated disease (PCVAD). PCV2 prevalence is highly variable, causing significant economic losses worldwide, mainly due to increases in mortality and decreased weight gain. Postweaning multisystemic wasting syndrome (PMWS) is the most significant manifestation, a disease characterized by clinical signs such as wasting, reduced weight gain, pallor of the skin, respiratory distress, diarrhea, and occasionally, icterus (Rosell et al., 2000; Segalés, 2012).

Passive immunity is the primary protection against infections in early live of neonates. It is widely believed that the main limitations of the immunization of neonates from vaccinated sows is the interference with maternal antibodies (Hodgins and Shewan, 2012). Ideally, PCV2 vaccination should be administered while residual MDA are minimal and before pigs become fully susceptible to infection (Chae, 2012). The transfer and persistence for 1–2 weeks of maternal cytokines such as IL-4, IL,6, IL10, IL12 and IFN-γ from sows colostrum/milk to neonates, is well documented (Nguyen et al., 2007).

Vaccination of sows and gilts increases PCV2-specific neutralizing antibodies (NA) in colostrum, reduces viremia and systematic PCV2 load, and improves production parameters of their piglets in field conditions (Pejsak et al., 2010; Gerber et al., 2011; Kurmann et al., 2011). The induction of PCV2-specific neutralizing antibodies and interferon γ-secreting cells (IFN-γ-SCs) by commercial subunit and inactivated vaccines have coincided with

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reductions in the PCV2 viremia (Fort et al., 2009a, 2009b; Opriessnig et al., 2010; Oh et al., 2012; Seo et al., 2012).

All commercial PCV2 vaccines have been developed to reduce PMWS impact in pigs by decreasing mortality and cull rates, frequency of coinfections, number of viremic pigs, viral load and viral-induced specific lymphoid lesions. In addition, PCV2 vaccination of piglets has been associated to significantly higher average daily weight gain (ADWG) (Fachinger et al., 2008; Horlen et al., 2008; Kixmöller et al., 2008; Ellis, 2014). The objective of this study was to compare anti-PCV2 antibodies in serum among vaccinated and non-vaccinated sows and subsequent vaccination/unvaccination of piglets, including viremia and production parameters of pigs under field conditions.

2. Materials and methods

This study was conducted between 2012 and 2013 in a farrow-to-finish farm. The system was experiencing high mortalities in the late nursery and/or early fattening pigs. PMWS was diagnosed using the internationally accepted criteria of clinical signs and gross lesions, histopathological findings and lymphocyte depletion of lymphoid tissues (Segalés et al., 2005). The farm located in South-Eastern Mexico with a strict all-in/all-out production system was maintained in the farrowing, nursery and fattening units. The reproductive herd consisted of 4500 sows and every week batch of 170–180 pregnant sows were introduced into farrowing houses. Piglets were weaned about 21 days (3 weeks) of life and then transferred into nursery units. At about 70 days (10 weeks) of life they were moved to the fattening units. The farm was seropositive but stable to porcine reproductive and respiratory syndrome virus, seronegative for swine influenza virus and *A. pleuropneumoniae*. Piglets were vaccinated for *H. parasuis* (weeks 1 and 3).

2.1. Sow and piglet experiment design

The control of PCVAD is based on vaccination against PCV2 and management strategies. Four commercial PCV2 vaccines registered for their application in piglets are currently available in Mexico. However, the four vaccines vary in the nature of the antigen, adjuvant types, recommended use (sows, piglets or sows and piglets) and in the dose of administration (Beach and Meng, 2012; Chae, 2012). Two of these vaccines (CircoFLEX®, Boehringer Ingelheim; Circumvent® PCV, Intervet/Merck) are subunit vaccines based on an open reading frame (ORF2) protein expressed in the baculovirus system. Circovac® (Merial) is composed of an inactivated, oil-adjuvanted PCV2a vaccine for use in sows, gilts and piglets. Fostera® PCV (Zoetis) has been introduced to the market, which is an inactivated attenuated chimeric PCV1-2 virus, containing the ORF2 capsid gene of the PCV2a cloned into the genomic backbone of the non-pathogenic PCV1 (Chae, 2012).

A total of 256 sows were used in the study, the dams were divided into 2 groups according parity: 217 were vaccinated twice, before farrowing (weeks 4 and 7) with 2 ml of vaccine B (Circovac, Merial) intramuscularly at the neck muscles, and 39 dams served as control group and received 2 ml of phosphate buffer saline (PBS) (non-vaccinated group); sows were mingled in the same farrowing and gestation units. Sow distribution, parity mean, piglets delivered and stillborns is shown in Table 1A. Three hundred seventy-three piglets (males and females) from non-vaccinated sows were injected with PBS (NV-NV group). The offspring of vaccinated sow were assigned to five groups: V-VA, V-VB, V-VC, V-VD (four commercial vaccines) and V-NV (control, Table 1B); being balanced by weight and sex, using a double blinded (neither the farmer nor the veterinarian knew which treatment was administered), controlled trial. The animals were individually identified with an ear tag at weaning. Piglets of each group were injected intramuscularly with PCV2 vaccines A (Fostera PCV, 2 ml, one dose at 3 weeks of age); B (Circovac, 0.5 ml, one dose at 3 weeks of age); C (Circoflex, 1 ml, one dose at 3 weeks of age), or D (Circumvent PCV, 2 ml, two doses at 3 and 6 weeks of age) according to each manufacturer's protocol. Three hundred seventy-six pigs were injected with PBS (V-NV group). All vaccinated and non-vaccinated piglets stayed comingled for the entire duration of the trial in the nursery and in the fattening facilities. This study was approved by the Animal Care and Ethics Committee of Meritorious Autonomous University of Puebla and all procedures complied with National Legislation Pertaining to Animal Health Research.

2.2. Sample collection

The sows were sampled three times during gestation by venipuncture from the jugular vein using vacutainers tubes (Becton Dickinson, USA), 7, 4 and 2 weeks before the expected farrowing date. Blood was collected from the jugular vein of pigs at 1, 3, 6, 10, 15, and 22 weeks of age. Blood samples were centrifuged at

Table 1.
Descriptive statistics of sows (A) and piglets (B) included in the study.

(A)

Groups	Sows	Sow parity		Piglets	Born alive		Stillborn	Mummies
		Mean	95% CI		Mean	95% CI		
Non-vaccinated	39	4.53	3.95–5.11	390	10.00	8.05–11.95	22	9
Vaccinated	217	4.70	4.48–4.92	2215	10.21	10.11–10.31	87	44

(B)

Groups	Vaccinated		Piglets[a]	Birth weight (kg)		Gender ratio (male:female)
	Sows	Piglets		Mean	95% CI	
NV-NV	No	No	373	1.37	1.36–1.38	51.7:48.3
V-VA	Circovac	Fostera	437	1.43	1.42–1.44	46.7:53.3
V-VB	Circovac	Circovac	424	1.41	1.40–1.42	51.4:48.6
V-VC	Circovac	Circoflex	432	1.35	1.34–1.36	49.1:50.9
V-VD	Circovac	Circumvent	417	1.41	1.40–1.42	49.9:50.1
V-NV(control)	Circovac	No	426	1.43	1.42–1.44	50.7:49.3

[a] At 3 weeks.

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