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## Surveillance of Classical Swine Fever Virus Antibody Titers in Sows and their Piglets under Different Vaccination Programs

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### Abstract

Classical swine fever virus (CSFV), serum neutralizing antibody titers of 854 sows were determined using a neutralizing peroxidase linked assay (NPLA). Blood samples were collected one-week post-partum from 1<sup>st</sup>- 6<sup>th</sup> parity sows, from 30 swine fever-free farms. The farms were divided according to their vaccination programs, 10 farms for each program. Program A sows had been vaccinated 3 weeks pre-partum (288 samples). Program B sows had been vaccinated 3 weeks post-partum (276 samples). Program C sows had been vaccinated 3 times/year (290 samples). The means log<sub>2</sub> CSFV antibody titer of the sows in programs A, B, C were 6.59 1.88, 5.72 2.04 and 6.61 2.04 respectively. Serum samples from 1 week old (1,924 samples) and 3 week old piglets (1,809 samples) born to the sows using the vaccination programs (A, B, C), from the 15 farms were collected and their CSFV maternal derived antibody titres were determined. The mean log<sub>2</sub> of the maternal derived, antibody titers in the piglets was seen to decrease with a half-life of approximately two weeks. The correlation between serum neutralizing antibody titers in the sows and their piglets was demonstrated by  $r^2 = 0.22$ . Our results showed that all the three vaccination programs provided the protective levels of antibody. Furthermore, it suggests that the profiles of the CSFV specific, neutralizing antibody titers in the sows can be used as a guideline for planning a classical swine fever vaccination program for their piglets.

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**Keywords :** Classical swine fever, maternal antibody, NPLA, sow, piglet.

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## บทคัดย่อ

### การศึกษาสถานภาพระดับภูมิคุ้มกันของโรคอหิวาต์สุกรในแม่และลูกสุกรในโปรแกรมวัคซีนต่างๆ

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ได้ศึกษาสถานภาพระดับแอนติบอดีต่อเชื้อไวรัสอหิวาต์สุกรในแม่สุกรจำนวน 854 ตัว ด้วยวิธีนิวทรัลไลซิง เพอร์ออกซิเดส ลิงค์ แอสเซ (Neutralizing Peroxidase Linked Assay; NPLA) เก็บตัวอย่างซีรัมจากแม่สุกรหลังคลอด 1 สัปดาห์ตั้งแต่ลำดับครอกที่ 1 ถึง 6 จากฟาร์มที่ไม่มีประวัติการระบาดของโรคอหิวาต์สุกรอย่างน้อย 2 ปี แบ่งฟาร์มตามโปรแกรม วัคซีนป้องกันโรคอหิวาต์สุกรโปรแกรมฯ ละ 10 ฟาร์มโปรแกรม A แม่สุกรฉีดวัคซีนก่อนคลอด 3 สัปดาห์ (288 ตัวอย่าง) โปรแกรม B แม่สุกรฉีดวัคซีนหลังคลอด 3 สัปดาห์ (276 ตัวอย่าง) โปรแกรม C ฉีดวัคซีน 3 ครั้ง/ปี (290 ตัวอย่าง) พบว่าค่าเฉลี่ย  $\log_2$  ของระดับแอนติบอดี (Mean SD) ในแม่ที่ฉีดวัคซีนโปรแกรม A, B, และ C เท่ากับ 6.59 1.88, 5.72 2.04 และ 6.61 2.04 ตามลำดับ และศึกษาสถานภาพภูมิคุ้มกันถ่ายทอดในลูกสุกรดูนมอายุ 1 และ 3 สัปดาห์ จำนวน 1,924 ตัวอย่างและ 1,809 ตัวอย่าง ตามลำดับ ที่เกิดจากแม่สุกรในแต่ละโปรแกรมจำนวน 15 ฟาร์ม พบว่าค่าเฉลี่ยของระดับภูมิคุ้มกันถ่ายทอดของลูกสุกรมีค่าครึ่งชีวิตประมาณ 2 สัปดาห์ และระดับภูมิคุ้มกันของแม่สุกรกับระดับภูมิคุ้มกันของลูกสุกรในกลุ่มที่ศึกษามีความสัมพันธ์เชิงบวก ( $r^2=0.22$ ) จากผลการศึกษานี้สามารถสรุปได้ว่าโปรแกรมวัคซีนในแม่สุกรทั้งสามโปรแกรมให้ภูมิคุ้มกันโรครุนแรง และระดับแอนติบอดีต่อเชื้อไวรัสอหิวาต์สุกรของแม่สุกรสามารถนำมาใช้เป็นแนวทางในการวางแผนโปรแกรมการฉีดวัคซีนป้องกันโรคอหิวาต์สุกรในลูกสุกรในฝูงได้

คำสำคัญ: ไวรัสอหิวาต์สุกร ภูมิคุ้มกันถ่ายทอด NPLA แม่สุกร ลูกสุกร

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## Introduction

Classical swine fever (CSF) is one of the top ranking important epidemic swine disease in Thailand. The disease was first reported in 1950 (Kongsamak, 1980). The etiological agent of CSF belongs to RNA virus, family Flaviviridae, genus *Pestivirus spp.*. Classical swine fever is a disease that is rapidly spread, with a high morbidity and mortality rate of up to 100% (Van Oirschot and

Terpstra, 1989). Different vaccination programs have been recommended (Paton and Greiser-Wilke, 2003). Despite such rigid vaccination programs, there have been difficulties in controlling the disease in some herds where it is endemic (Geerts et al., 1995; Mangen et al., 2002; Morilla and Carvajal, 2002). A major reason for vaccination failure in the piglets born to immunized sows has been ascribed to the presence

of colostral derived, Classical Swine Fever virus (CSFV) antibodies (Parchariyanon et al., 1994). It has been reported that the an average maternal immunity in piglets  $\geq 32$  can interfere the active immune response of the piglets (Suvintarakorn et al., 1995). A national development program for the control and research on CSF had been implemented, under the National Institution of Animal health (NIAH), DLD, MOAC Thailand, since 1994. Neutralizing, peroxidase linked, assay (NPLA) has been developed for determining serum neutralizing antibody titers (SNT) as a CSF national serological test (Parchariyanon et al., 1997). In Thailand, routine vaccination is practiced and is compulsory. There are two mainly types of modified live virus vaccines, a lapinized virus vaccine and a tissue culture derived vaccine. The commonly used vaccine program for sows includes pre-partum, post-partum and a mass vaccination program, which vaccinates at least three times a year. The objectives of this study was to compare the immune status of the sows and their piglets using the three vaccination programs which are used in Thailand. The results would be useful for planning future vaccination programs in the herd and for the prevention and control of classical swine fever in Thailand.

### Materials and Methods

CSFV serum neutralizing antibody titers in 854 sows were determined using a previous described NPLA method (Parchariyanon et al., 1997). Blood samples were collected at one-week post-partum from 1<sup>st</sup>- 6<sup>th</sup> parity sows in 30 farrowing to finisher classical swine fever-free farms, with no previous history of outbreaks over the past 2 years. They were based in Nakornpathom and Ratchaburi provinces. The farms were grouped according to their vaccination programs which used modified live vaccines (10 farms/program). In Program A, the sows had been vaccinated at 3 weeks post-partum

(288 samples). In Program B, the sows had been vaccinated at 3 weeks post-partum (276 samples), and in Program C, the sows had been vaccinated 3 times/year along with the rest of animals on the farm (290 samples). The level of maternal derived antibody from one- week- old piglets (1,924 samples) and three- week- old piglets (1,809 samples) born to the sows in programs A, B and C (5 farms/program) were determined. Statistical analysis of the SN antibody titers in the sows and piglets were calculated using ANOVA. The relationship between the SN antibody titers in the sows and the piglets was done by a correlation coefficient.

### Results

The mean SD  $\log_2$  CSFV antibody titers in the sows in program A was 6.59 1.88 which was similar to that in program C sows (6.61 2.04). The mean SD  $\log_2$  CSFV antibody titers of the sows in program B (5.72 2.04) was significantly lower than program A and program C sows ( $p < 0.05$ ). The parity results showed that antibodies in program A sows gradually decreased over 4, 5, 3, 2, 1, 6 parities; in program B over 6, 5, 2, 4, 3, 1 and in program C over 4, 5, 2, 3, 6, 1. shown in Table 1 and Fig. 1. The serum samples from 1 week old piglets in programs A, B, and C provided; 580, 673 and 672 samples and the 3 weeks old piglets provided; 541, 644 and 624 samples respectively. The mean SD  $\log_2$  of the maternal derived antibody titers in 1 week and 3 week old piglets from the sows in program A, were 6.13 1.92 and 4.85 1.63 which was similar to that of program C (6.30 2.01; and 5.84 2.33). The mean titer of the maternal derived antibody in program B (5.31 1.65 and 4.08 1.32) was significantly lower than programs A and C ( $p < 0.05$ ). Statistical analysis demonstrated that antibody titers in one-week-old piglets in program B were significantly different from those in A and C ( $p < 0.05$ ). Three-week-old piglets in programs A, B and C, all had significantly

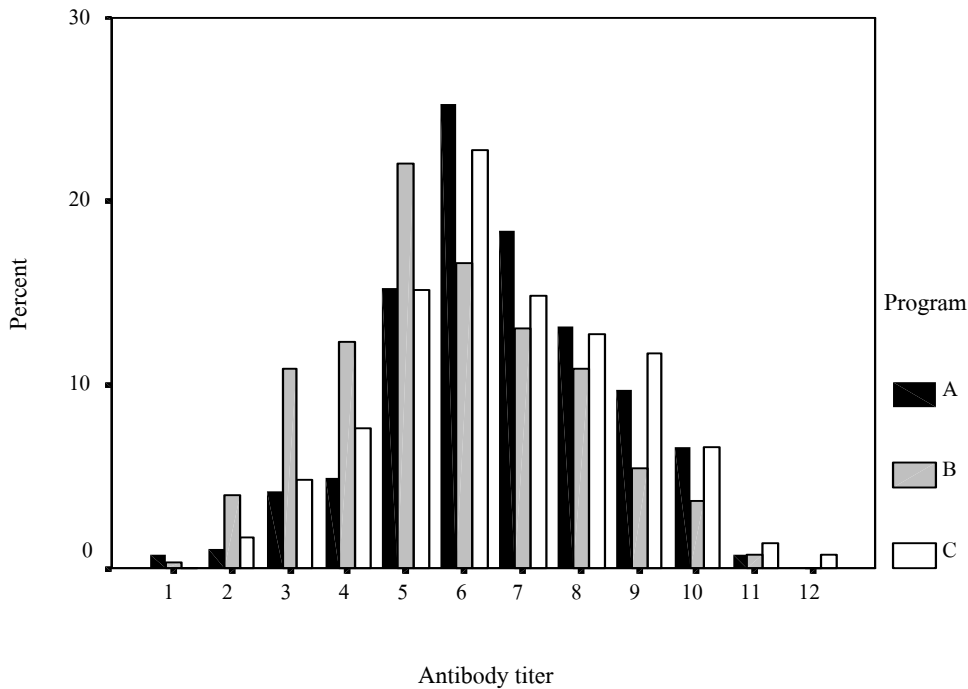
different titers ( $p < 0.05$ ). Statistical analyses were shown in Table 2. The mean of  $\log_2$  maternal derived antibody titers of piglets in the two groups were

correlated well with their dams using linear correlation with a coefficient of determination ( $r^2$ ) = 0.22 (Fig. 2).

**Table 1** The mean of  $\log_2$  (mean SD) of CSFV antibody titers in sows using different vaccination programs.

Vaccine programs	Parity of sows												mean (n)	
	1		2		3		4		5		6			
A	6.42	1.82	6.50	1.81	6.54	2.15	7.08	1.82	7.00	1.69	5.96	1.87	6.59	1.88 <sup>a</sup>
	(48)		(48)		(46)		(50)		(48)		(48)		(288)	
B	5.30	2.35	5.81	2.13	5.57	2.01	5.74	1.95	5.91	1.61	6.02	2.17	5.72	2.04 <sup>b</sup>
	(47)		(47)		(47)		(46)		(47)		(42)		(276)	
C	6.12	2.00	6.80	2.25	6.72	2.15	6.98	1.87	6.81	2.02	6.18	1.87	6.61	2.04 <sup>a</sup>
	(49)		(49)		(50)		(50)		(48)		(44)		(290)	

<sup>a,b</sup> ( $p < 0.05$ )

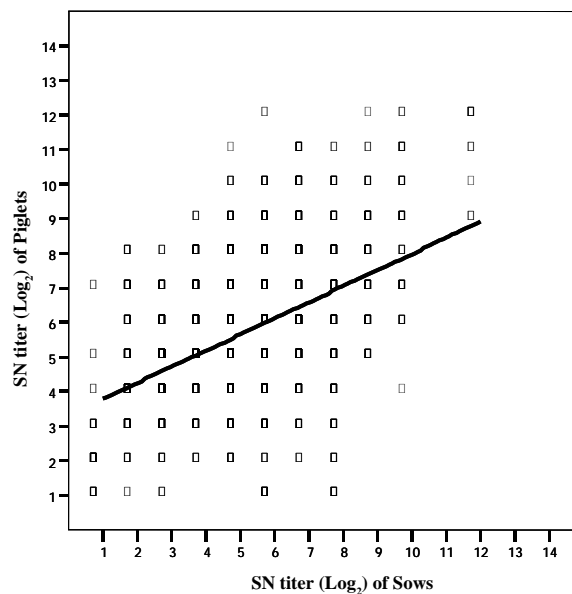


**Figure 1** A histogram of the percentage of sows at mean  $\log_2$  of CSFV antibody titers of sows using different vaccination programs.

**Table 2** The mean of log<sub>2</sub> (mean SD) of CSFV antibody titers from piglets when 1 week-old and 3 weeks-old in different vaccination programs.

Vaccine programs	1 week-old piglet (n)	3 week-old piglet (n)
A	6.13 1.92 <sup>a</sup> (580)	4.85 1.63 <sup>c</sup> (541)
B	5.31 1.65 <sup>b</sup> (673)	4.08 1.32 <sup>d</sup> (644)
C	6.30 2.01 <sup>a</sup> (672)	5.84 2.33 <sup>e</sup> (624)
Mean (n)	5.90 1.92 (1,925)	4.41 0.50 (1,809)

<sup>1</sup> week old piglet <sup>a,b</sup> ( $p < 0.05$ ), <sup>3</sup> week old piglet <sup>c,d,e</sup> ( $p < 0.05$ )



SN titer (piglet) = 3.34 + 0.47 \* SN titer (sows)  
R square = 0.22

**Figure 2** The scatter diagram indicating the linear relationship of the SN titer (mean log<sub>2</sub>) against CSFV in sows and their piglets. The equation below the diagram is a linear regression equation with a coefficient of determination ( $r^2$ ) = 0.22.

### Discussion

This study used neutralizing peroxidase linked assay (NPLA) to determine the serum neutralizing antibody titer (SNT), which demonstrates a reliable CSFV antibody level for the herd (Parchariyanon et al., 1997). The results showed that the mean SN antibody titers from programs A and C were statistically different from that of program B, which is in agreement with Damrongwatanapokin et al. (1998). This could be an effect of the different intervals between the last vaccination and the time of blood collection. The interval for programs A and C were at 3.7 and 5.5 weeks respectively, while that of program B was 13.4 weeks. Additionally, variations among the studied farms i.e management, infection prevalence of the farm, as well as the type of vaccine could affect the outcome of the vaccination program (Damrongwatanapokin et al. 1998). However, the average antibody titers for the three vaccination programs showed normal distribution with an average SN titer  $> 32$  (the  $\log_2$  of antibody titer  $> 5$ ) in 60-80 % of the studied sow population in all programs. This level of active SNT has been shown to be protective (Terpstra and Wensvoort, 1988). Thus, all the three vaccination programs gave a sufficient level of protection in the herds. With regard to parity, the results showed the best CSFV antibody titers occurred in the 4<sup>th</sup> and 5<sup>th</sup> parities. These findings corresponded well with previous reports (Nuntaprasert et al., 1992). The mean  $\log_2$  for maternal antibody titers in the 3 weeks old piglets was at  $4.41 \pm 0.50$ , which suggested that there would be no interference from maternal derived antibody when these piglets were vaccinated when  $> 3$  weeks old (Parchariyanon et al., 1994; Geerts et al., 1995; Suvintarakorn et al., 1995). The half life of maternal derived antibody was approximately 2 weeks, which is in agreement with a previous report (Coggins, 1964). It is generally accepted that only one vaccination, at an appropriate time (7-9 weeks of age), when the

interference from maternal antibody has decreased, is adequate to induce protective immunity (Geerts et al., 1995). The recommendation may be valid in a CSF free herd but cannot be applicable in situations where CSF is endemic. Therefore, twice or early vaccination in very young pigs has been the common strategy in practice (Luengyosluetchakul et al., 1993). In this study, the CSFV antibody titers in sows correlated well with their piglets. Thus, the SNT obtained from the sows could be used for predicting and planning the vaccination program for their piglets. In conclusion, all three vaccination programs were protective and routine serosurveillance in the sows is recommended to assist the control of CSF in Thailand

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