EFFECTS OF DIFFERENT PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VACCINE REGIMES ON PIG IMMUNITY STATUS IN SELECTED PIG FARMS IN MALAYSIA

CHEAH ZI HERK

FPV 2019 8

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By

CHEAH ZI HERK

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Veterinary Science

May 2019

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DEDICATION

MY FATHER AND MOTHER,

I Love You Forever

MY WIFE,

For all the love that you have gave to me

MY SIBLINGS,

For all the support and patience you have shown me

MY BEST FRIENDS – the G.A. Gang,

For the times you were there in my ups and downs

MY COLLEAGUES

For backing me up in my working place

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Veterinary Science

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May 2019

Chairman : Associate Professor Ooi Peck Toung, DVM, PhD
Faculty : Veterinary Medicine

Vaccination is a key component of PRRS disease control strategies. Various types of vaccines, including killed virus (KV) and modified-live virus (MLV) vaccines had been develop for the control of the disease. In Malaysia field condition, the producers adopted different vaccination regime which either breeder vaccination only or whole herd (both breeder and porker herd) vaccination regime. Therefore, the ideal vaccines option (strain or type) and vaccination approach had remained highly debatable in the market. Thus, the objective of this study is to determine the pig immunity status against PRRS in farm by comparing different farms which practicing different vaccination regime or different types of PRRS vaccines in Malaysia farm condition by using PCR and ELISA technique to check on the vertical and horizontal disease transmission and disease pressure in the farm. There are 4 vaccinations regime being include in this study where Farm A only vaccinated Type 2 MLV in breeder herd, Farm B vaccinated both Breeder and porkers with Type 2 MLV, Farm C only vaccinated Type 1 killed vaccine (KV) in Breeder herd and Farm D vaccinated both Breeder and porker with type 1 MLV. All samples collected from all farms were test with both PCR and ELISA. Results showed that whole herd vaccinating MLV approach is a better option for PRRSv control in the farm compare to breeder approach (Chapter 3). In the farm that practiced whole herd vaccination approach, Type 2 MLV showed its benefit in establishing the dominant strain in the farm and able to better control of PRRSv circulation in the farm as compare to Type 1 MLV (Chapter 4). When comparing between Type 2 MLV and Type 1 KV in breeder herd vaccination approach (Chapter 5), the study showed that Type 2 MLV demonstrated its benefit in controlling PRRSv shedding in the herd over Type 1 KV. The conclusion obtain from this research to combat PRRS by strategically practice whole herd vaccination regime (Chapter 3), using the Type 2 (US strain) vaccine strain (Chapter 4) and MLV type vaccine (Chapter 5).

Key words: PRRS immunity, Whole-herd vaccination, modified live vaccine (MLV), killed vaccine (KV)

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Perubatan Veterinar

KESAN REJIM VAKSINASI REPRODUKTIF DAN PERNAFASAN SINDROME (PRRS) YANG BERBEZA TERHADAP STATUS IMMUNITY BABI DI LADANG BABI TERPILIH DI MALAYSIA

Oleh

CHEAH ZI HERK

Mei 2019

Pengerusi : Profesor Madya Ooi Peck Toung, DVM, PhD
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Vaksinasi adalah komponen utama untuk strategi kawalan penyakit PRRS. Pelbagai jenis vaksin, termasuk vaksin virus yang tidak aktif (KV) dan vaksin virus hidup yang diubah suai (MLV) telah dibangunkan untuk mengawal penyakit PRRS. Dalam keadaan lapangan Malaysia, pengeluar menerima vaksin rejim yang berlainan, sama ada vaksinasi pada pembiakan baka atau vaksinasi keseluruhan (vaksin pembiakan baka dan babi daging) terhadap PRRSv. Selain itu, pelbagai jenis vaksin PRRS dan rejim vaksinasi di pasaran menjadikan ideal vaksin dan rejim vaksin selalu dipersoalkan dan belum terbukti. Oleh itu, objektif kajian ini adalah untuk menentukan status imuniti babi terhadap PRRS di ladang dengan menggunakan teknik PCR dan ELISA dan membandingkan ladang-ladang yang mengamalkan rejim vaksinasi yang berbeza atau jenis-jenis vaksin PRRS dalam keadaan ladang Malaysia. Teknik PCR dan ELISA boleh menentukan tekanan penyakit PRRS di ladang daripada penilaian cara-cara penyebaran penyakit adalah tegak penyerbaran atau datar penyebaran. 4 rejim vaksinasi telah termasuk dalam kajian ini di mana Ladang A hanya memberi vaksinasi PRRS jenis 2 vaksin hidup yang diubah suai (MLV) dalam pembiakan baka, Ladang B memberi vaksini kepada pembiakan baka dan babi daging dengan PRRS jenis 2 vaksin MLV, Ladang C hanya pembiakan baka divaksinasi oleh PRRS jenis 1 vaksin tidak aktif (KV) dan Ladang D vaksinasi pembiakan baka dan babi daging dengan PRRS jenis 1 vaksin MLV. Semua sampel yang dikumpulkan dari semua ladang dan diujikan dengan cara PCR dan ELISA. Hasilnya menunjukkan bahawa seluruh vaksinasi (pembiakan baka dan babi daging) adalah pilihan yang lebih bermutu untuk memberi kawalan PRRSv dalam ladang berbanding dengan vaksinasi pembiakan baka sahaja (Bab 3). Jika dalam ladang yang memberi vaksinasi keseluruhan, vaksin PRRS jenis 2 tunjuk kelebihan dalam membina dominasi PRRSv dalam ladang dan dapat mengawal peredaran PRRSv berbanding dengan PRRSv jenis 1 (Bab 4). Vaksin jenis 2 MLV menunjuk kelebihan dalam kawalan PRRSv peredaran dalam ladang jika berbanding dengan vaksin jenis 1 tidak aktif (KV) (Bab 5). Kesimpulanya, pengamalan rejim vaksinasi keseluruhan (Bab 3) dengan menggunakan vaksin PRRS jenis 2 (Bab 4) dan jenis vaksin MLV (Bab 5).

Kata Kunci: PRRS immuniti, seluruh vaksinasi, vaksin virus hidup yang diubah suai (MLV), vaksin virus yang tidak aftif (KV)

ACKNOWLEDGEMENTS

I would like to sincerely acknowledge the support and guidance I received from my supervisors especially the chairperson, Assoc Prof Dr Ooi Peck Toung, first for giving me the opportunity to work together with his swine team and for showing me his patience, guidance and support, mentally and financially, throughout the period of my study. To other members of my supervisory committee, Assoc Prof Dr Phang Lai Yee, I humbly appreciate your diligent efforts, positive suggestions and valuable observations which have guided me on my academic endeavours.

I would like to acknowledge the contribution of the staff of various laboratory, such as the UPM Swine Virology Laboratory and various people whom I would like to extend a personal note of thanks:

Dr. Kam Kok Yen, Vynter Low Suet Ee, Dr.Vivian Chua, Dr. Ng Zi Yao, Dr. Michelle Fong Wai Cheng, Mr. Yoong Lee Kong, Dr.Yong Chiun Khang, Dr. Evonne Lim, Dr. Eric Cheah Heng Chow, Dr. Sia Bang Wen, Dr. Lim Zhi Jian, Dr. Frankie Lau Pick Ping, Dr. Lee Chee Yien, Dr. Liew Hui Xian and Dr. Tan Shin-Yi.

Thank you for contributing to the completion of my project.

I am indebted to my family, especially my mother for her full support during the entire course of my endeavour. Her unique patience, unconditional love, motivation and understanding were the foundation of my completion. I sincerely appreciate all the love that she has given me. My achievement, it was due, no doubt, to my upbringing and love from my parents.

My special gratitude to my wife, Dr. Loong Wai Cheng, who has given me unconditional love, understanding and assurance that ensures the successful completion of my study, without which this may not be possible. This is for us, and for our future.

Last but not least, I would also like to thank my friends who have given me immense inspiration and motivation throughout my study.

I certify that a Thesis Examination Committee has met on 3 May 2019 to conduct the final examination of Cheah Zi Herk on his thesis entitled "Effects of Different Porcine Reproductive and Respiratory Syndrome Vaccine Regimes on Pig Immunity Status in Selected Pig Farms in Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Veterinary Science.

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This thesis was submitted to the Senate of University Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Veterinary Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

ASSV	American Association of Swine Veterinarian
CD	Plasma Membrane Glycoprotein Receptor
DC-SIGN	Dendritic Cell-Specific ICAM-3 Grabbing Nonintegrin
ELISA	Enzyme-Linked Immunosorbent Assay
EU	European Strain
GP5	Glycoprotein
HP-PRRS	Highly Pathogenic Porcine Reproduction and Respiratory Syndrome
IM	Intramuscular
LV	Lelystad virus
KV	Killed vaccine
M	Membrane Protein
MLV	Modified Live Virus
N	Nucleocapsid
OIE	World Organisation for Animal Health
ORF	Open Reading Frame
PRRS	Porcine Reproductive and Respiratory Syndrome
PRRS-CAP	PRRS- Coordinated Agriculture Project
PRRSv	Porcine Reproductive and Respiratory Syndrome virus
PCR	Polymerase Chain Reaction
RNA	Ribonucleic acid
rRNA	Ribosomal Ribonucleic Acid
RT-PCR	Reverse Transcription Polymerase Chain Reaction
SD	Standard Deviation
S / P ratio	Ratio of Scotopic to Photopic Lumens
SPSS	Statistical Package for Social Sciences
SRCR	Scavenger Receptor Cystein-Rich
US	North American, United States Strain
USDA	United States Department of Agriculture
VN antibodies	Virus Neutralizing Antibodies

CHAPTER 1

INTRODUCTION

1.1 Overview

Porcine reproductive and respiratory and syndrome (PRRS), is a disease caused by PRRS virus (PRRSv), which is one of the clinically relevant and economically significant diseases in Malaysia (Neumann *et al.*, 2005). As the name suggests, the clinical signs of the disease include respiratory failure, seen in growing pigs and piglet, and also late-term reproductive failure, seen in sows and gilts. PRRSv can be classified into two different strains, Type I strain (European strain, Lelystad virus, LV) and also Type II strain (North American strain, VR-2332). The classification can be based on the entire genome or the 3'-terminal structural genes (T. Kim et al., 2015; Zhou et al., 2018). The highly pathogenic PRRSv (HP-PRRSv) strains was first detected in China in the year 2006, where infected pigs were developing clinical signs such as anorexia, respiratory distress with very high mortality and morbidity rates, high fever (above 41°C), red discoloration of skin and other clinical signs (Tian *et al*., 2007). Subsequently, HP-PRRSv strains have since been reported all around the Eastern Asian countries, such as Philippines, Laos, Bhutan, Myanmar, Thailand, Cambodia, South Korea, and Russia (Ni *et al.*, 2012).

In Malaysia, a seroprevalence study showed that 82.4% of the pigs, tested in 94% farms were seropositive for PRRS (Jasbir *et al.*, 2008). More recently in 2012, a study showed that all the farms in Malaysia that were tested, 100% of it were seropositive, with 89.2% of the pigs seropositive (Kiu & Ooi, 2012).

Being within the order Nidovirales, family Arteriviridae, genus Arterivirus, PRRS is a small (approximately 50-65nm in diameter), enveloped, positive-sensed and single-stranded RNA virus. There are two antigenically and genetically different strains of PRRSv which are Type I virus in Europe and Type II in North American. Nowadays, both types share worldwide distribution with Type II predominant in North America and Asia (Zimmerman *et al.*, 2012). The viral genome is around 15 kbp long and encodes nine open reading frames, namely ORF1a, 1b, 2a, 2b, 3, 4, 5, 6, and 7 (Stadejek et al., 2002). Within the different ORFs, the more conserved ORF7 is recommended as a potential target site for detection of PRRSv of different strains using RT-PCR (Guarino *et al.*, 1999).

The most frequently used tests to diagnose PRRS include ELISA, RT-PCR and serological assays. However, serological data alone may not be sufficient to identify and define the immune status towards PRRS in a breeding herd (S. Dee & Philips, 1997). In conjunction with this, molecular techniques, observations of clinical signs, and analysis of production data are also used simultaneously to determine the PRRSv immunity status of a breeding herd. Through continuous monitoring, these data can also be used to

identify and isolate the duration in the life of the piglet, where the infection started / occur for future pig flow management (S. Dee & Philips, 1997).

Although elimination of PRRSv or maintaining a PRRSv-free herd can be attempted (Charerntantanakul, 2012), the virus is shed readily by infected swine and is highly transmissible via aerosols and fomites, explaining the persistency of the disease in the farm environment. It has also been reported that the virus is still infectious, even after 9.1km of airborne transmission (Otake *et al.*, 2010; Pileri & Mateu, 2016).

Due to the huge impact of PRRS in the industry, vaccination is one of the most important disease control strategies. Various types of vaccines, including killed virus (KV) and modified-live virus (MLV) vaccines had been developed for the control of the disease in both grower and breeding sow (Martínez-Lobo et al., 2013).

Killed/Inactivated PRRS vaccines are known as safe but confer limited protection against either homologous or heterologous virus. PRRS killed vaccine seems to be able to reduce the disease severity when administered to the PRRSv-infected pigs (Charerntantanakul, 2012). Another finding also showed that killed vaccine failed to prevent reproductive losses and congenital infection in fetuses (Scortti *et al.*, 2007). Besides, KV was also proven to have provided weak memory responses with sequential challenge without any obvious active immune responses in the vaccinated pigs (Kim *et al.*, 2011).

PRRS MLV vaccine is well known for its protective efficacy against PRRSv that are genetically homologous to the vaccine virus (Nan *et al.*, 2017). Some of its advantages it has over killed vaccine includes: (I) the ability to generate stronger and more complete immune response, (II) the ability for PRRSv neutralization, (III) the ability to limit post-challenge viremia, transplacental infection and viral shedding, and (IV) protection against clinical disease (Schelkopf *et al.*, 2014). Piglets born to vaccinated gilts also had higher body weight and survival rate at weaning than those born to non-vaccinated control gilt (Piontkowski *et al.*, 2016; Rowland, 2010).

However, there is concern for the immunogenicity and safety of MLV vaccine (Charerntantanakul, 2012). Vaccination with PRRS-MLV is generally contraindicated in pregnant swine as a safety precaution and the main target populations are the growing and finishing pigs. The MLV vaccine virus replicates in the host, which allows shedding of attenuated PRRSv and creates the potential for exposure of immunologically naïve swine to the vaccine virus. Experimental and field studies reported that MLV strains can cause viremia, revert to virulence and spread transplacentally affecting the piglets born (Papatsiros, 2012). Piglets born to these MLV-infected sows can become carriers of PRRSv, shedding the MLV vaccine virus to other naive pigs (Rowland, 2010).

In Malaysia field condition, PRRS vaccine in breeding herd is generally accepted by the producers while piglet's vaccination rate against PRRSv still remain low. Whole herd

vaccination regime (vaccinate both breeding herd and piglets) against PRRSv is not common in Malaysia pig industry. Furthermore, the presence of various type of vaccines and vaccination regimes in the market make the ideal type of vaccines and vaccination regime approach remain questionable and debatable and yet to be proven.

1.2 Objectives

The objective of this study is to

1. Determine which type of vaccination regimes and types of vaccine is able to provide a better immunity against PRRS in selected pig farms in Malaysia by using PCR and ELISA technique.
2. To classify the herd PRRSv status by using American Association of Swine Veterinarian (ASSV) classification scheme in selected pig farms in Malaysia.

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