UNIVERSITI PUTRA MALAYSIA

SEROLOGICAL STATUS AND ASSOCIATED RISK FACTORS OF AUJESZKY'S DISEASE AND CLASSICAL SWINE FEVER IN PENINSULAR MALAYSIA

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By

LOW SUET EE

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

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DEDICATION

MY PARENTS
For loving me and be there for me no matter what happens

BROTHERS AND COUSINS
For supporting me, entertaining me,
and helping me out whenever I need help

SUPERVISORS
For all the support and patience throughout the journey of my study

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For all the support, care, and laughter brought to me

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For all the care, support and understandings given

The People Who Have Shaped Me to Become Who I Am Today

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

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November 2019

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Aujeszky's Disease (AD) and Classical Swine Fever (CSF) are endemic viral diseases causing great economic impact to the pig industry with limited data about the current disease status in Malaysia. Hence, our study was aimed to determine the serological status of AD and CSF, investigate ADV field challenge and CSF protection, and identify the possible risk factors contributed to the current situation in Peninsular Malaysia swine farms based on commercial samples submitted to UPM during 2016-2017. In this study, convenient sampling method was used and questionnaire was carried out in accessible farms. ELISA test was conducted using IDEXX Pseudorabies Virus gpI Antibody Test Kit for AD and IDEXX Classical Swine Fever Ab ELISA Test Kit for CSF serology diagnosis. Seroprevalence of AD indicates the infection status while seroprevalence of CSF signifies humoral protection status in this study. All tested farms were categorized according to their location into three categories, (northern, central, and southern region). A total number of 71 farms with 2192 serum samples were submitted for AD ELISA test from 2016 to 2017. Overall AD infection rate is 75.87% from the farms in Peninsular Malaysia submitted to UPM within 2016 to 2017. Seroprevalence in 2017 was higher than the year before. Infection was seen more in breeder herd, especially in sows. Findings shown small-scale farms and open-housed system in farms were associated with the increased risk of AD infection when tested with multinomial logistic regression statistical test. For CSF, 58 farms with 2073 samples in total were received from 2016 to 2017. Farm status classification system was developed in our study with the aim to differentiate the CSF serology results into three status categories (ideal, moderate, and less ideal) according to defined criteria. Generally, 44.78% of the farms were categorized as ideal farm status with overall seroprevalence of 71.37%. Highest seropositive farms were obtained from southern region while northern region

had the lowest. Significant associations were found in small-scale farms, vaccine brand, and single vaccination with seronegativity. Inversely, vehicle dip and foot dip were significantly related with seropositive of CSF indicating these practices were important in preventing diseases from entering the farm. Based on the findings in our study, current status of AD is stable while current CSF vaccination program is still insufficient to provide ideal humoral protection in Malaysia.

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

STATUS SEROLOGIK DAN FAKTOR RISIKO BERKAITAN PENYAKIT AUJESZKY DAN PENYAKIT DEMAM BABI KLASIK DI SEMENANJUNG MALAYSIA

Oleh

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Penyakit Aujeszky (AD) dan Demam Babi Klasik (CSF) adalah penyakit virus endemik yang memberi impak ekonomi yang besar kepada industri babi dan data mengenai status semasa penyakit ini di Malaysia adalah terhad. Oleh itu, kajian ini bertujuan untuk menentukan status serologi AD dan CSF, menyiasat infeksi lapangan ADV dan perlindungan CSF, dan mengenal pasti faktor risiko yang mungkin menyumbang kepada keadaan semasa di ladang babi di Semenanjung Malaysia berdasarkan sampel komersial yang dikemukakan kepada UPM pada 2016- 2017. Dalam kajian ini, kaedah pensampelan mudah digunakan dan soal selidik dijalankan di ladang yang boleh diakses. Ujian ELISA dilakukan menggunakan IDEXX Pseudorabies Virus gpI Kit Ujian Antibodi untuk AD dan IDEXX Fever Swine Class Ab ELISA Test Kit untuk diagnosis serologi CSF. Seroprevalence AD menunjukkan status jangkitan sementara seroprevalence CSF menandakan status perlindungan humoral dalam kajian ini. Semua ladang yang diuji dikategorikan mengikut lokasi mereka kepada tiga kategori, (wilayah utara, tengah, dan selatan). Sejumlah 71 ladang dengan 2192 sampel telah dihantar untuk ujian AD ELISA dari 2016 hingga 2017. Kadar jangkitan AD keseluruhan ialah 75.87% daripada ladang di Semenanjung Malaysia yang dihantar kepada UPM pada 2016 hingga 2017. Seroprevalence pada tahun 2017 adalah lebih tinggi daripada tahun sebelum ini. Jangkitan telah dilihat lebih banyak dalam pembiakbaka penternakan, terutamanya pada babi betina. Penemuan yang ditunjukkan oleh ladang kecil dan sistem terbuka di ladang dikaitkan dengan peningkatan risiko jangkitan AD apabila diuji dengan ujian statistik regresi logistik multinomial. Bagi CSF, 58 ladang dengan jumlah sampel 2073 diterima dari 2016 hingga 2017. Sistem klasifikasi status ladang telah dibangunkan dalam kajian kami untuk membezakan hasil serologi CSF dalam tiga kategori status (ideal, sederhana, dan kurang ideal) mengikut kriteria yang ditentukan. Umumnya, 44.78%

daripada ladang dikategorikan sebagai status ladang yang ideal dengan seroprevalence sebanyak 71.37%. Ladang seropositif tertinggi diperolehi dari bahangian selatan manakala bahagian utara mencatatkan bacaan yang paling rendah. Hubungkait yang signifikan ditemui pada ladang kecil, jenama vaksin, dan vaksin tunggal dengan seronegativiti. Sebaliknya, pembasmian kuman pada kenderaan dan kaki berkait rapat dengan seropositif CSF menunjukkan amalan-amalan ini penting dalam mencegah penyakit daripada memasuki ladang. Berdasarkan penemuan dalam kajian ini, status AD semasa adalah stabil sementara program vaksin CSF semasa masih tidak mencukupi untuk menyumbangkan perlindungan humoral yang ideal di Malaysia.

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

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LIST OF ABBREVIATIONS

%	Percent
>	More than
<	Less than
µl	Microliter
AD	Aujeszky's Disease
ADV	Aujeszky's Disease Virus
CNS	Central Nervous System
CSF	Classical Swine Fever
CSFV	Classical Swine Fever Virus
CTB	Complex-trapping-blocking
CV%	Coefficient of variation
DIVA	Differentiating Infected from Vaccinated Animals
DVS	Department of Veterinary Services Malaysia
ELISA	Enzyme-linked immunosorbent assay
FAVN	Fluorescent antibody virus neutralization
FVM	Faculty of Veterinary Medicine
gB	Glycoprotein B
gC	Glycoprotein C
gD	Glycoprotein D
gE	Glycoprotein E
gG	Glycoprotein G
gH	Glycoprotein H
gI	Glycoprotein I
gII	Glycoprotein II

gIII	Glycoprotein III
gK	Glycoprotein K
gL	Glycoprotein L
gM	Glycoprotein M
gN	Glycoprotein N
gp50	Glycoprotein 50
gp63	Glycoprotein 63
GPE-	Japanese guinea-pig exaltation-negative
gX	Glycoprotein X
IPMA	Immunoperoxidase monolayer assay
LAT	Latex agglutination test
MDA	Maternal derived antibody
MLV	Modified Live Vaccine
NPLA	Neutralizing peroxidase-linked assay
PCV	Porcine circovirus
PK-15	Porcine kidney-15
PRRS	Porcine reproductive and respiratory syndrome
S/N	Serum to negative ratio
SN	Serum neutralization
UPM	Universiti Putra Malaysia
US	United States
VNT	Virus neutralization test

CHAPTER 1

INTRODUCTION

1.1 Overview

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Malaysia is a country with 92.1% of self-sustainability of pork from its pig industry. Self-sufficiency ratio of pork was the third-highest in livestock production of Malaysia and accounted for estimation of RM3.5 billion in 2018 (Department of Statistics Malaysia., 2018; Department of Veterinary Services Malaysia., 2018). There are 486 pig farms with 1,470,659 of standing pig population currently in Peninsular Malaysia (Department of Veterinary Services Malaysia., 2019). The number of farms had been decreasing along the years due to closing of several small scale farms but the number of standing pig population remains the same as larger-scale farms had been expanding their production capacity (Federation of Livestock Farmers' Associations of Malaysia (FLFAM)., 2018).

Various porcine viral diseases exist in Malaysia, whereby Aujeszky's disease (AD) and Classical Swine Fever (CSF) are two of the most common viral endemic diseases in local. Both diseases are important transboundary diseases that able to cause great economic impact to the industry. Despite the existence of the two diseases and routine vaccination for nearly 40 years in Malaysia, no serological status data were available for CSF while serological status of AD had been absent for nearly two decade. Therefore, this is the first study to report CSF and AD serological status in pig farms at Peninsular Malaysia and to study the possible risk factors related to the two diseases.

AD is a herpes viral disease which is also known as pseudorabies or 'mad itch' in the past. ADV is classified under genus *Varicellovirus in* subfamily *Alphaherpesvirinae* within the family of *Herpesviridae.* Its taxonomic name is Suid herpesvirus-1 (SuHV-1). One of the significant characteristics is that it develops a lifelong latent infection in their natural host's neurons.

For Southeast Asia, Singapore is the first country diagnosed with AD in 1970. Subsequently, another outbreak was reported in 1977, which the duration is concurrent with the increase of number of AD cases in Malaysia. However, AD was not widespread and endemic in Malaysia during that time. Until late 1984, an epizootic of AD had become nationwide, and then develop to become endemic in the country. It's believed that the disease was brought in via importation into Malaysia (Too, 1997b). Susceptibility to AD infection is affected by several factors: (1) virus strain's virulence, (2) quantity of virus upon infection, (3) infection route, (4) species of animal host, (5) age of the animal and (6) the host's condition.

Classical Swine Fever (CSF), which also known as hog cholera, is a highly contagious swine viral disease under family *Flaviviridae*, genus *Pestivirus*. It is antigenically and structurally related to bovine viral diarrhoea virus (BVDV) and border disease virus (BDV). CSFV genome is made up of 12.3kb which contains one open reading frame (ORF). CSFV appears to exhibit significant heterogeneity in the rates of evolutionary changes among genotypes. Different nomenclatures have been used to describe the various virus groups and subgroups.

In Malaysia, CSF was first encountered during 1895 whereby severe regional outbreak consistently occurred within 1936 to 1983. Attribution to the local massive production of GPE- strain vaccine by Veterinary Research Institute and increased awareness of the pig farmers upon its importance, the intensity of the infection gradually became lesser in 1975 thereby only occasional herd outbreaks occurred. Vaccination is effectively controlling the disease in previously and thus, it was believed that lapses in vaccination practice were the main influential factors for the occurrence of farm outbreaks, especially on the weaner herd. Severity of the infection is mostly associated with virulence of the virus and the host's age. The latest record of severely CSF outbreak was reported in early 1995 in east Malaysia due to importation or smuggling of pigs from West Malaysia (Too, 1997a).

Vaccination has been made compulsory for CSF by Department of Veterinary Services Malaysia but not AD. However, AD was commonly vaccinated in the industry. In practice, vaccination for AD is recommended to implemented doubly at 10 weeks old and 13 to 14 weeks old for the porker herd (Too, 1997b). In CSF endemic herds, it was previously recommended to vaccinate the weaner and sow together during weaning and then revaccinate them at 3 or 5 months of age (Too, 1997a). Meanwhile, another method was recommended by a study in Thailand (CSF endemic country), where sows are suggested to be vaccinated either 2 to 3 weeks before or after farrowing or mass vaccination in 4 months interval, while for weaners, single vaccination in 7 to 8 weeks upon the absence of outbreak of clinical CSF or double vaccination during 5 weeks and 9 weeks old in high infection risk area (Direksin et al., 2016).

1.2 Justification

Undeniably, both diseases have existed in the country for more than 40 years but the disease status remains unknown. Information and data about these two diseases are inadequate and limited. Furthermore, risk factors related to the current AD and CSF status in Malaysia has not being studied. The prevention measures in farm remain unknown and not comprehended. Despite the long term vaccination practice against ADV and CSFV, the intensity of viral spread among local pig farm remains unidentified.

1.3 Objectives

The objectives of this research are

1. To determine the serological status of AD and CSF in Peninsular Malaysia swine farms based on commercial samples submitted to UPM during 2016-2017.

2. To investigate ADV field exposure in Peninsular Malaysia swine farms based on commercial samples submitted to UPM during 2016-2017.

3. To investigate and CSF protection level in Peninsular Malaysia swine farms based on commercial samples submitted to UPM during 2016-2017.

4. To identify the possible risk factors contributed to the current situation of AD and CSF in Peninsular Malaysia based on data collected via questionnaire surveys.

1.4 Hypothesis

It is hypothesised that

1. ADV field exposure exhibits differences across different region in Peninsular Malaysia.

2. CSF protection level exhibits differences across different region in Peninsular Malaysia.

3. Risk factors could affect the ADV field exposure and CSF protection level which contributed to the current situation of the two diseases in Peninsular Malaysia.

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