

Porcine Viruses

From Pathogenesis to Strategies for Control

<https://doi.org/10.21775/9781910190913>

Edited by

Hovakim Zakaryan

Group of Antiviral Defense Mechanisms
Institute of Molecular Biology of the
National Academy of Sciences
Yerevan
Armenia



Copyright © 2019

Caister Academic Press
Norfolk, UK

www.caister.com

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-910190-91-3 (paperback)
ISBN: 978-1-910190-92-0 (ebook)

Description or mention of instrumentation, software, or other products in this book does not imply endorsement by the author or publisher. The author and publisher do not assume responsibility for the validity of any products or procedures mentioned or described in this book or for the consequences of their use.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher. No claim to original U.S. Government works.

Ebooks

Ebooks supplied to individuals are single-user only and must not be reproduced, copied, stored in a retrieval system, or distributed by any means, electronic, mechanical, photocopying, email, internet or otherwise.

Ebooks supplied to academic libraries, corporations, government organizations, public libraries, and school libraries are subject to the terms and conditions specified by the supplier.

Contents

	Preface	v
1	African Swine Fever Virus Erik Arabyan, Armen Kotsinyan, Astghik Hakobyan and Hovakim Zakaryan	1
2	Classical Swine Fever Virus Sandra Blome	21
3	Foot-and-Mouth Disease Virus Francisco Sobrino, Flavia Caridi, Rodrigo Cañas-Arranz and Miguel Rodríguez-Pulido	43
4	Porcine Circoviruses Sheela Ramamoorthy and Pablo Piñeyro	81
5	Porcine Epidemic Diarrhoea Virus Changhee Lee	107
6	Porcine Parvovirus André Felipe Streck and Uwe Truyen	135
7	Porcine Reproductive and Respiratory Syndrome Virus Alexander N. Zakhartchouk, Sujit K. Pujhari and John C.S. Harding	149
8	Swine Vesicular Disease Virus Estela Escribano-Romero, Miguel A. Martín-Acebes, Angela Vázquez-Calvo, Emiliana Brocchi, Giulia Pezzoni, Francisco Sobrino and Belén Borrego	181
	Index	199

Current Books of Interest

The Prion Protein	2019
Plant Genomics	2019
Methylotrophs and Methylotroph Communities	2019
Microbial Ecology: Current Advances from Genomics, Metagenomics and Other Omics	2019
Plant-Microbe Interactions in the Rhizosphere	2018
Prions: Current Progress in Advanced Research (Second Edition)	2019
Microbiota: Current Research and Emerging Trends	2019
<i>Lactobacillus</i> Genomics and Metabolic Engineering	2019
Cyanobacteria: Signaling and Regulation Systems	2018
Viruses of Microorganisms	2018
Protozoan Parasitism: From Omics to Prevention and Control	2018
Genes, Genetics and Transgenics for Virus Resistance in Plants	2018
DNA Tumour Viruses: Virology, Pathogenesis and Vaccines	2018
Pathogenic <i>Escherichia coli</i> : Evolution, Omics, Detection and Control	2018
Postgraduate Handbook: A Comprehensive Guide for PhD and Master's Students and their Supervisors	2018
Enteroviruses: Omics, Molecular Biology, and Control	2018
Molecular Biology of Kinetoplastid Parasites	2018
Bacterial Evasion of the Host Immune System	2017
Illustrated Dictionary of Parasitology in the Post-Genomic Era	2017
Next-generation Sequencing and Bioinformatics for Plant Science	2017
The CRISPR/Cas System: Emerging Technology and Application	2017
Brewing Microbiology: Current Research, Omics and Microbial Ecology	2017
Metagenomics: Current Advances and Emerging Concepts	2017
<i>Bacillus</i> : Cellular and Molecular Biology (Third edition)	2017
Cyanobacteria: Omics and Manipulation	2017
Brain-eating Amoebae: Biology and Pathogenesis of <i>Naegleria fowleri</i>	2016
Foot-and-Mouth Disease Virus: Current Research and Emerging Trends	2017
<i>Staphylococcus</i> : Genetics and Physiology	2016
Chloroplasts: Current Research and Future Trends	2016
Microbial Biodegradation: From Omics to Function and Application	2016

Preface

For humans, pork meat is one of the most complete dietary sources of protein. According to the Food and Agriculture Organization of the United Nations, animal protein production will grow three times by 2050, and meat production, including of pork, will double. An increase in intensification is necessary, because arable land cannot be increased in proportion. However, viral diseases cause significant animal losses and represent a major threat to global pig farming industry. Therefore, the understanding of molecular biology, pathogenesis, host–virus interaction and epidemiology of these viruses is essential for reducing the burden of viral outbreaks.

The overall aim of this book is to review the most important and dangerous porcine viruses that have emerged in the global swine population. It covers different DNA and RNA viruses about which we have learnt much during the last decades. In Chapter 1, my colleagues and I discuss African swine fever virus (ASFV), the causative agent of highly lethal haemorrhagic fever of domestic pigs and wild boar. It is a large, enveloped, double-stranded DNA virus that is the only known DNA arbovirus since it is transmitted by soft ticks of the genus *Ornithodoros*. Most recently, ASFV was introduced into Georgia and then spread to the Russian Federation, Belarus, Ukraine, and some EU member states. In the absence of effective vaccines and antiviral drugs, this virus continues to pose a global risk for pig industry. Chapter 2 is about classical swine fever virus (CSFV), a small enveloped RNA virus of the genus *Pestivirus* in the *Flaviviridae* virus family. Although live attenuated vaccines are currently available, it remains a major threat to profitable pig production worldwide because CSFV infection is still associated with high mortality rates. Sandra Blome summarizes CSFV properties, pathogenesis, clinical picture and control options. Chapter 3 focuses on foot-and-mouth disease virus (FMDV), which is the prototypic member of the *Picornaviridae* family. It causes an acute systemic vesicular disease affecting livestock worldwide. Francisco Sobrino and colleagues discuss different aspects of FMDV infection, including new strategies for viral control by vaccination and other antiviral strategies. This chapter also covers the current approaches for virus diagnosis. In Chapter 4, Sheela Ramamoorthy and Pablo Piñeyro provide an overview of porcine circoviruses, focusing particularly on porcine circovirus strain 2 (PCV2), which was first isolated in 1997. PCV2 is a single-stranded DNA virus belonging to the *Circoviridae* family. PCV2 infection by itself causes only mild disease but co-factors such as other infections are involved in the development of severe diseases. Molecular biology, pathogenesis, immune response, diagnosis and control strategies are discussed in detail. Chapter 5 is about porcine epidemic diarrhoea virus (PEDV), the aetiological agent of severe diarrhoea and dehydration. Although this virus was first reported in

Europe, it has become problematic in Asian countries such as China, Japan, Thailand and the Philippines. Owing to high morbidity and mortality in piglets, PEDV has a substantial economic burden in affected countries. Changhee Lee discusses molecular and cellular biology of the virus, as well as diagnostic procedures, epidemiology and control strategies. In Chapter 6, André Felipe Streck and Uwe Truyen describe the biology, pathogenic potential and strain variation of porcine parvovirus (PPV). This virus is considered the main cause of reproductive disorders in pigs with no maternal clinical signs. PPV is a small, non-enveloped, single-stranded DNA virus belonging to the *Parvoviridae* family. Although losses are low in vaccinated herds, PPV can cause devastating abortion storms in unvaccinated herds, or in those herds, where new antigenic types are circulating. Chapter 7 is devoted to porcine reproductive and respiratory syndrome virus (PRRSV), a small enveloped RNA virus belonging to the *Arteriviridae* family. PRRSV causes reproductive failure in herds and respiratory tract illness in young pigs. In this chapter, Alexander Zakhartchouk and colleagues summarize the current understanding of PRRSV, including the virus molecular biology, virus–host cell interactions, pathogenesis, diagnostic procedures and epidemiology. They also provide an overview of currently available vaccines and a novel vaccine development. The last chapter (Chapter 8) is about swine vesicular disease virus (SVDV), which belongs to the *Enterovirus* genus within the *Picornaviridae* family. SVDV is genetically highly related to the human coxsackie virus B5. It causes a vesicular disease with clinical signs similar to those of foot-and-mouth disease. Francisco Sobrino, Belén Borrego and colleagues discuss different aspects essential for understanding the infectious cycle of SVDV. They also provide an overview of current strategies for SVDV control by vaccination and other antiviral strategies.

It took about a year to complete this book, during which time the chapters were written, edited and re-edited in order to improve and present high-quality reading material. My primary acknowledgement must go to all our contributing authors for their significant work, enthusiasm and cooperation. In addition, I thank Annette Griffin from Caister Academic Press for her great assistance and patience during all this time. Finally, but most importantly, I wish to extend appreciation to my family members, particularly to my beautiful wife, Kamila, for her invaluable support throughout the writing and editing process.

Dr Hovakim Zakaryan