WOAH Reference Laboratory Reports Activities 2022

Activities in 2022

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Laboratory Information

Name of disease (or topic) for which you are a designated WOAH Reference Laboratory:	Foot-and-mouth disease
Address of laboratory:	177, Heokisin 8-ro, Gimchoen-si, Geongsangbuk-do
Tel.:	+82-54-912-0902
E-mail address:	parkjhvet@korea.kr
Website:	www.qia.go.kr
Name (including Title) of Head of Laboratory (Responsible Official):	Bong-Kyun Park, Commissioner of APQA(Animal and Plant Quarantine Agency)
Name (including Title and Position) of WOAH Reference Expert:	Jong-Hyeon Park, Head of Center for FMD Vaccine Research
Which of the following defines your laboratory? Check all that apply:	Governmental

TOR1: DIAGNOSTIC METHODS

1. Did your laboratory perform diagnostic tests for the specified disease/topic for purposes such as disease diagnosis, screening of animals for export, surveillance, etc.? (Not for quality control, proficiency testing or staff training)

Yes

Diagnostic Test	Indicated in WOAH Manual (Yes/No)	Total number of test performed last year	
Indirect diagnostic tests		Nationally	Internationally
ELISA(SP Antibody)	YES	617767	0
ELISA(NSP Antibody)	YES	619532	0
Direct diagnostic tests		Nationally	Internationally
Virus isolation	YES	0	23
Antigen ELISA	YES	0	0

Real-time RT-PCR	YES	423	23
VP1 gene sequencing	YES	0	12

TOR2: REFERENCE MATERIAL

2. Did your laboratory produce or supply imported standard reference reagents officially recognised by WOAH?

No

3. Did your laboratory supply standard reference reagents (nonWOAH-approved) and/or other diagnostic reagents to WOAH Members?

No

4. Did your laboratory produce vaccines?

No

5. Did your laboratory supply vaccines to WOAH Members?

No

TOR3: NEW PROCEDURES

6. Did your laboratory develop new diagnostic methods for the designated pathogen or disease?

No

7. Did your laboratory validate diagnostic methods according to WOAH Standards for the designated pathogen or disease?

No

8. Did your laboratory develop new vaccines for the designated pathogen or disease?

No

9. Did your laboratory validate vaccines according to WOAH Standards for the designated pathogen or disease?

No

TOR4: DIAGNOSTIC TESTING FACILITIES

10. Did your laboratory carry out diagnostic testing for other WOAH Members?

No

11. Did your laboratory provide expert advice in technical consultancies on the request of an WOAH Member?

No

TOR5: COLLABORATIVE SCIENTIFIC AND TECHNICAL STUDIES

12. Did your laboratory participate in international scientific studies in collaboration with WOAH Members other than the own?

Yes

Title of the study	Duration	PURPOSE OF THE STUDY	PARTNERS (INSTITUTIONS)	WOAH MEMBER COUNTRIES INVOLVED OTHER THAN YOUR COUNTRY
Comparative studies for avian influenza virus and FMD virus between Korea	10 years(2014-2024)	Studies on genetic characterization of foot and mouth disease viruses	NCVD (National Center for Veterinary Diagnosis)	VIETNAM

and Vietnam		and avian influenza virus in Vietnam		
Comparative studies for avian influenza virus and FMD virus between Korea and Cambodia	5 years(2018-2022)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in Cambodia	NAHPRI (National Animal Health and Production Research Institute)	CAMBODIA
Comparative studies for avian influenza virus and FMD virus between Korea and LAO PDR	5 years(2018-2022)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in LAO PDR	NAHL (National Animal Health Laboratory)	LAOS
Comparative studies for FMD virus between Korea and Bangladesh	5 years(2020-2024)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in Bangladesh	CDIL(Central Disease Investigation Laboratory)	BANGLADESH
Establishing technology of identifying FMD genes to use molecular epidemiology and building NGS	3years(2020-2022)	For establishing the leading analytical technology of viral genomic epidemiology that can scientifically support epidemiological studies in response to FMD outbreaks and building NGS platform for rapid pan genome analysis	The Pirbright Institute	UNITED KINGDOM

TOR6: EPIZOOLOGICAL DATA

14. Did your Laboratory collect epidemiological data relevant to international disease control?

15. Did your laboratory disseminate epidemiological data that had been processed and analysed?

16. What method of dissemination of information is most often used by your laboratory? (Indicate in the appropriate box the number by category and list the details in the box)

a) Articles published in peer-reviewed journals:

13

1. Enhanced detection and serotyping of foot-and-mouth disease virus serotype O, A, and Asia1 using a novel multiplex real-time RT-PCR. Lim DR et al. Transbound Emerg Dis. 2022 Sep;69(5):e2578-e2589.
2. Antiviral effect of vesatolimod (GS-9620) against foot-and-mouth disease virus both in vitro and in vivo. Lee G et al. Antiviral Res. 2022 Sep; 205:105384.
3. BacMam expressing highly glycosylated porcine interferon alpha induces robust antiviral and adjuvant effects against foot-and-mouth disease virus in pigs. Kim A et al. J Viro. 2022 Jun 22;96(12):e0052822.
4. Establishment and validation of a liquid-phase blocking ELISA for the detection of antibodies elicited by the foot-and-mouth disease

virus A/ASIA/Sea-97 lineage. Lee SH et al. J App Ani Res. 2022, Vol.50, No.1, 490-497.
5. Modification of carboxy-terminal amino acid composition to enhance expression of foot-and-mouth disease virus VP4 protein. Park SY et al. J Prev Vet Med. 2022 Sep. Vol.46, No.3:114-120.
6. Comparison of High-Performance Liquid Chromatography with Sucrose Density Gradient Ultracentrifugation for the Quantification of Foot-and-Mouth Disease Vaccine Antigens. Kim AY et al. Vaccines (Basel). 2022 Apr 22;10(5):667.
7. Development of monoclonal antibody to specifically recognize VP0 but not VP4 and VP2 of foot-and-mouth disease virus. Park SY et al. Pathogens. 2022 Dec 8;11(12):1493.
8. Factors Involved in Removing the Non-Structural Protein of Foot-and-Mouth Disease Virus by Chloroform and Scale-Up Production of High-Purity Vaccine Antigens. Park SY et al. Vaccines (Basel). 2022 Jun 24;10(7):1018.
9. The C3d-fused foot-and-mouth-disease vaccine platform overcomes maternally-derived antibody interference by inducing a potent adaptive immunity. Lee MJ et al. NPJ Vaccines. 2022 Jun 28;7(1):70.
10. Age-Dependent Dynamics of Maternally Derived Antibodies (MDAs) and Understanding MDA-Mediated Immune Tolerance in Foot-and-Mouth Disease-Vaccinated Pigs. Shin S et al. Vaccines (Basel). 2022 Apr 24;10(5):677.
11. Foot-and-Mouth Disease Virus 3Cpro Cleaves BP180 to Induce Blister Formation, Ekanayaka P et al., Viruses. 2022 Sep 16;14(9)2060.
12. Efficacy of a Novel Multiepitope Vaccine Candidate against Foot-and-Mouth Disease Virus Serotype O and A. Chathuranga WAG et al., Vaccines (Basel). 2022 Dec 19;10(12):2181.
13. Foot-and-mouth disease virus non-structural protein 2B downregulates the RLR signalling pathway via degradation of RIG-I and MDA5. Weerawardhaba A et al. Front Immunol. 2022 Sep 29; 13:1020262.

b) International conferences:

12
1. Serological surveillance of FMD immunity level in Republic of Korea, 2021 (Seo HJ et al., EuFMD OS 2022)
2. Field application of novel solid phase blocking ELISA for antibody detection to FMDV type-A (Park MY et al., EuFMD OS 2022)
3. Identification of Foot-and-mouth disease virus genotype circulating in Laos between 2018 and 2020 (Ryoo S et al., EuFMD OS 2022)
4. Phylogenetic analysis of FMDV circulating in Bangladesh, 2021 (Cha SH et al., EuFMD OS 2022)
5. Molecular characterization of foot-and-mouth disease viruses isolated from vietnam during 2019-2021 (Ryoo S et al., EuFMD OS 2022)
6. Validation of digital rt-pcr: sensitive and rapid detection of foot and mouth disease virus(Lim DR et al., EuFMD OS 2022)
7. Efficacy study of FMD vaccines against the challenge of the OCATHAY isolate for the efficient control in pigs (Kim S et al., EuFMD OS 2022)
8. BacMam expressing a highly glycosylated porcine IFN-a induces robust antiviral and adjuvant effects against foot-and-mouth disease virus in pigs (Kim SM et al., 16th Vaccine Congress)
9. Development and evaluation of a liquid-phase blocking ELISA for the detection of antibodies to foot-and-mouth disease vaccine strain A/Pocheon/SKR/2010 (Kim M et al., EuFMD OS 2022)
10. Evaluation of the efficacy in pigs by vaccination of commercially available foot-and-mouth disease vaccines against heterologous challenge with A/Asia/G-VII lineage viruses (Moon S et al., EuFMD OS 2022)
11. Development of FMD vaccine for intradermal inoculation for swine (Kim DW et al., EuFMD OS 2022)
12. Development of foot-and-mouth disease intradermal vaccine for early protection in swine (Cho GY et al., 16th Vaccine Congress)

c) National conferences:

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1. Development of solid-phase competitive ELISA for detection of structural protein antibodies against foot and mouth disease virus serotype Asia 1. (Han Y et al., 2022 KSVS Autumn Conference)
2. Proficiency testing using serum panels tailored for foot-and-mouth disease regional veterinary services in 2021(Kim TW et al., 2022 KSVS Autumn Conference)
3. Post-vaccination monitoring of foot-and-mouth disease in 2021 (Seo HJ et al.,2022 KSVS Autumn Conference)
4. Phylogenetic analysis of Foot-and-Mouth Disease Viruses circulating in Southeast Asia from 2020 to 2021 (Eom T et al., 2022 KSVS Autumn Conference)
5. Identification of Foot-and-mouth disease virus (FMDV) genotype circulating in Bangladesh in 2021 (Eom T et al., 2022 KSVS Autumn Conference)

6. Comparison of different non-structural protein assays with foot-and-mouth disease reference sera panel (2022 KSVS Spring Conference)
7. Development of semiconductor based multiplex real time RT-PCR for detection of Foot and mouth disease virus serotype O, A and Asia1 (Park HJ et al.,2022 KSVS Autumn Conference)
8. The efficient control of the O Cathay isolate with application of altered regimen of foot-and-mouth diseases vaccines in pigs (Kim J et al., 2022 KVS Conference)
9. Efficacy study of Foot-and-mouth disease vaccines against the challenge of the O/Cathay isolate for the efficient control of initial outbreak(Kim J et al., 2022 KSPVM Conference)
10. Efficacy study of early protection against the challenge of the O/ME-SA/PanAsia field isolate in vaccinated pigs 2022 KSPVM Conference (Kim J et al., 2022 KSPVM Conference)
11. Antiviral effect of GS-9620 against foot-and-mouth disease virus both in vitro and in vivo (Kang HR et al., The Federation meeting of Korean Basic Medical Scientists 2022)
12. BacMam expressing highly glycosylated porcine interferon alpha induces robust antiviral and adjuvant effects against foot-and-mouth disease virus in pigs (Kim SM et al., The Federation meeting of Korean Basic Medical Scientists 2022)
13. CRISPR-Cas9 mediated knockout of IFNAR1 in HEK293 suspension cells enhance the production efficiency of protein or viral vector related with interferon (Aro Kim et al., 2022 KSVS Autumn Conference)
14. Type A chimeric vaccine strain for broad antigenic coverage shows complete protection in pigs against three different lineages of foot-and-mouth disease virus (Shin SH et al., 2022 KVS Conference)
15. Evaluation of chimeric vaccine strain with broad antigenicity against Foot-and-Mouth Disease type O (Hwang SY et al., 2022 KVS Conference)
16. Chimeric vaccine strain of type A broad antigenic coverage shows complete protection in pigs against different lineages of foot-and-mouth disease virus (Shin SH et al., 2022 KSVS Autumn Conference).
17. Evaluation of vaccine strains developed for efficient protection with a broad range against foot-and-mouth disease type O (Hwang SY et al., 2022 KSVS Autumn Conference).
18. Comparison of high-performance liquid chromatography with sucrose density gradient ultracentrifugation for the quantification of foot-and-mouth disease vaccine (Kim D et al., 2022 KSVS Autumn Conference)
19. Modification of carboxy-terminal amino acid composition to enhance expression of foot-and-mouth disease vbirus VP4 protein (Kim D et al., 2022 KSVS Autumn Conference)
20. Application of high-performance liquid chromatography to replace sucrose density gradient ultracentrifugation for the quantification of foot-and-mouth disease vaccine antigens (Ko YJ et al., MSK 2022)
21. Development of a vaccine antigen manufacturing process without eliciting antibodies against the non-structural proteins of foot-and-mouth disease viruses (Park SY et al., KSMCB 2022)
22. Manufacture of FMD vaccine antigen using LSBL3 (Ko YJ, 2022 Korea Biosafety Conference)
23. Novel strategies for the production of high-purity foot-and-mouth disease vaccines (Park SY et al., 2022 KVS Conference
24. A novel method using chloroform for the process of manufacturing high-purity foot-and-mouth disease vaccine (Park SY et al., KSMCB 2022)
25. Validation of pre-treatment methods for the in-process quantification of foot-and-mouth disease vaccine antigens using high performance liquid chromatography (HPLC) (Jin JS et al., 2022 KSVS Spring Conference)
26. Production of serotype O foot-and-mouth disease vaccine antigen using pilot-scale equipment (Kim J et al., 2022 KSVS Spring Conference)
27. Indirect efficacy estimation of foot-and-mouth disease type Asia-1Shamir vaccine using neutralizing antibody titer as a correlate of protection against the homologous challenge (Kim SW et al., 2022 KVS Conference)
28. Antigenic cross-reactivity between foot-and-mouth disease A/Asia/Sea-97 field viruses and vaccine strains (Kim SW et al., 2022 KVS Conference)
29. A liquid-phase blocking ELISA using foot-and-mouth disease vaccine strain (ASKRPocheon2010) for post-vaccination monitoring (Kim HH et al., 2022 KVS Conference)
30. Assessment for antigenic relatedness of foot-and-mouth disease O/ME-SA/PanAsia field viruses with vaccine strains (Kim HH et al., 2022 KVS Conference)
31. Use of logistic regression model for estimation of neutralizing antibody titer as a correlate of protection against foot-and-mouth disease type Aisa-1/Shamir (Kim J et al., 2022 KSPVM Conference)
32. Development of a liquid-phase blocking ELISA based on foot-and-mouth disease virus OmPanAsia-2(R) for post-vaccination sero-monitoring (Kim J et al., 2022 KSPVM Conference)
33. Establishment of a liquid-phase blocking ELISA using foot-and-mouth disease vaccine strain ASKRPocheon2010 (Kim J et al., 2022

KSPVM Conference)
34. Antigenic cross-reactivity of foot-and-mouth disease A/Asia/Sea-97 field viruses with vaccine strains (Moon SY et al., 2022 KSVS Spring Conference)
35. Antigenic cross-reactivity of foot-and-mouth disease O/ME-SA/PanAsia field viruses with vaccine strains (Moon SY et al., 2022 KSVS Spring Conference)
36. SM-IM3 acts as an immune-stimulating foot-and-mouth disease vaccine adjuvant that defends the host through simultaneous induction of robust cellular and humoral immunity (Kim HW et al., KAI International Meeting 2022)
37. SM-IM3 acts as an immunostimulating foot-and-mouth disease vaccine adjuvant to simultaneously induce robust cellular and humoral immunity. (Kim HW et al., 2022 KVS conference)
38. The C3d-fused foot-and-mouth-disease vaccine platform elicits the effect of overcoming the maternally-derived antibody interference by inducing a potent adaptive immunity (Lee MJ et al., KAI International Meeting 2022)
39. The efficacy study of commercially available foot-and-mouth disease vaccines against heterologous challenge with A/Asia/G-VII lineage viruses in pigs (Kim HH et al., 2022 KVS Conference)
40. Protective efficacy of commercial foot-and-mouth disease vaccines in pigs against heterologous challenge with A/Asia/G-II lineage virus isolated from Bhutan (Kim MY et al., 2022 KSVS Spring Conference)
41. Evaluation of the level of protection in pigs by vaccination of commercial foot-and-mouth disease vaccines against heterologous challenge with A/Asia/G-VII lineage virus isolated from Turkey (Kim SW et al., 2022 KSVS Spring Conference)
42. Development of foot-and-mouth disease pseudovirus capable of gene delivery (Cho KY et al., The Federation meeting of Korean Basic Medical Scientists 2022)
43. Immunogenicity study by inoculation site of needle0free syringe used for intradermal foot-and-mouth disease vaccination (Kim DW et al., The Federation meeting of Korean Basic Medical Scientists 2022)
44. Optimal adjuvants study for effective immunity to intradermal foot-and-mouth disease vaccine (Kim DW et al., The Federation meeting of Korean Basic Medical Scientists 2022)
45. Effective adjuvants for high immunity to intradermal foot-and-mouth disease vaccine (Kim DW et al., 2022 KSVS Autumn Conference)
46. Swine protection in the early stage with intradermal vaccine against type A foot-and-mouth disease virus isolated in Korea, 2018 (Kim DW et al., 2022 KSVS Autumn Conference)

d) Other (Provide website address or link to appropriate information):

1
Monthly National sero-surveillance results for overall population immunity and prevalence of infection surveillance (in Korean, www.qia.go.kr)

TOR7: SCIENTIFIC AND TECHNICAL TRAINING

17. Did your laboratory provide scientific and technical training to laboratory personnel from other WOAH Members?

Yes

a) Technical visit : 0

b) Seminars : 23

c) Hands-on training courses: 0

d) Internships (>1 month) 0

Type of technical training provided (a, b, c or d)	Country of origin of the expert(s) provided with training	No. participants from the corresponding country
B	Philippines	10
B	Sri Lanka	4
B	Malaysia	2

B	Vietnam	2
B	Kazakhstan	5

TOR8: QUALITY ASSURANCE

18. Does your laboratory have a Quality Management System?

Yes

Quality management system adopted	Certificate scan (PDF, JPG, PNG format)	
ISO/IEC 17025:2017		20230203_KT372_Animal and Plant Quarantine Agency(Department of Animal and Plant Health Research)_Eng.pdf

19. Is your quality management system accredited?

Yes

Test for which your laboratory is accredited	Accreditation body
Antigen detection(Realtime RT-PCR, RT-PCR, Antigen ELISA)	KOLAS(Korean Laboratory Accrediation)
Antibody detection(SP ELISA, NSP ELISA)	KOLAS(Korean Laboratory Accrediation)

20. Does your laboratory maintain a “biorisk management system” for the pathogen and the disease concerned?

Yes

Operation of BLS2 and BSL3 laboratories, preparation of biosafety management guidelines

TOR9: SCIENTIFIC MEETINGS

21. Did your laboratory organise scientific meetings related to the pathogen in question on behalf of WOAH?

No

22. Did your laboratory participate in scientific meetings related to the pathogen in question on behalf of WOAH?

Yes

Title of event	Date (mm/yy)	Location	Role (speaker, presenting poster, short communications)	Title of the work presented
WOAH/FAO Reference Laboratory Network Annual Meeting	2022-11-28	Netherlands	speaker	FMD-related activities in 2022 of Animal and Plant Quarantine Agency
The 3rd Regional Expert Group(REG) Meeting on FMD	2022-06-02	Online	speaker	Molecular diagnostic algorithm for FMD
The High-Level Consultation meeting on FMD control policy options and implications	2022-05-27	Online	speaker	Experience with FMD control in the Republic of Korea
The 26th WOAH Sub-commission for SEACFMD	2022-03-18	Online	speaker	FMD situation and its prevention and control

TOR10: NETWORK WITH WOAH REFERENCE LABORATORIES

23. Did your laboratory exchange information with other WOAH Reference Laboratories designated for the same pathogen or disease?

No

24. Are you a member of a network of WOAH Reference Laboratories designated for the same pathogen?

Yes

PURPOSE OF THE PROFICIENCY TESTS: 1	ROLE OF YOUR REFERENCE LABORATORY (ORGANISER/ PARTICIPANT)	NO. PARTICIPANTS	PARTICIPATING WOAH REF. LABS/ ORGANISING WOAH REF. LAB.

25. Did you organise or participate in inter-laboratory proficiency tests with WOAH Reference Laboratories designated for the same pathogen?

No

26. Did your laboratory collaborate with other WOAH Reference Laboratories for the same disease on scientific research projects for the diagnosis or control of the pathogen of interest?

Yes

TITLE OF THE PROJECT OR CONTRACT	SCOPE	NAME(S) OF RELEVANT WOAH REFERENCE LABORATORIES
Establishing technology of identifying FMD genes to use molecular epidemiology and building NGS	To carry out a collaborative research project on Molecular epidemiology and NGS platform studies on foot and mouth disease virus (FMDV) between APQA, Korea and WRLFMD, United Kingdom, for establishing the leading analytical technology of viral genomic epidemiology that can scientifically support epidemiological studies in response to FMD outbreaks and building NGS platform for rapid pan genome analysis	The Pirbright Institute, UK

TOR11: OTHER INTERLABORATORY PROFICIENCY TESTING

27. Did your laboratory organise or participate in inter-laboratory proficiency tests with laboratories other than WOAH Reference Laboratories for the same pathogen?

Yes

Purpose for inter-laboratory test comparisons1	Role of your reference laboratory (organizer/participant)	No. participating laboratories	Region(s) of participating WOAH Member Countries
National PTS	Oraganizer	46	Asia and Pacific

TOR12: EXPERT CONSULTANTS

28. Did your laboratory place expert consultants at the disposal of WOAH?

No

29. Additional comments regarding your report:

No