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for Animal Health
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Republic of China



Advances in fundamental research on FMD in LVRI

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Lanzhou Veterinary Research Institute

05-2025

Lanzhou Veterinary Research Institute (LVRI)

We mainly engaged in the Basic and Applied Research for prevention and control of Major Animal Infectious diseases, Parasitic diseases and Zoonotic diseases caused by Viruses, Bacteria and Parasites.



Viral diseases

Foot and Mouth Disease (FMD), African Swine Fever (ASF), Lumpy Skin Disease (LSD) and Sheep/Goat Pox, Peste Des Petits Ruminants (PPR), animal coronavirus infection such as PEDV/TGEV, and also PRRS etc



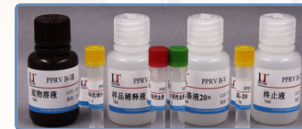
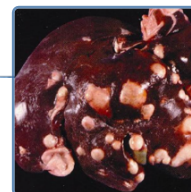
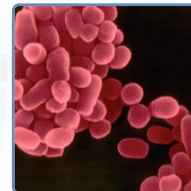
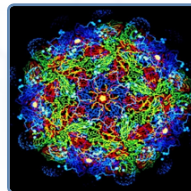
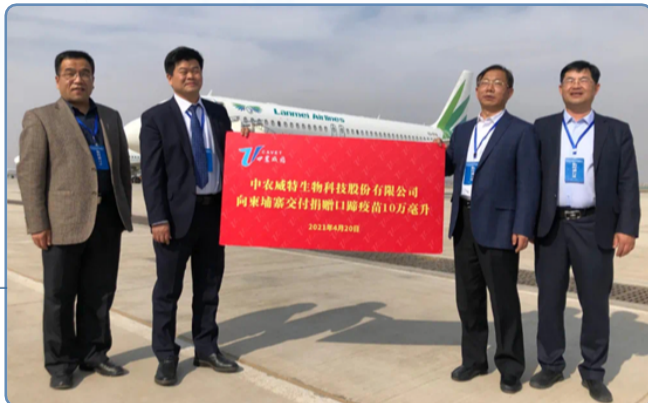
Bacterial diseases

Brucellosis, Animal Tuberculosis, Mycoplasmosis, etc.



Parasites-related diseases

Hydatid Disease, Toxoplasmosis and Tick-Borne Diseases like Theileriosis, etc..



Lanzhou Veterinary Research Institute (LVRI)



Administration building



Academic building - SKLADCP



Biosafety level-3 facility



A corner of LVRI

WOAH/National Ref Lab for FMD

- **Center of FMD diagnosis, fundamental research, translational research and consulting service in China.**

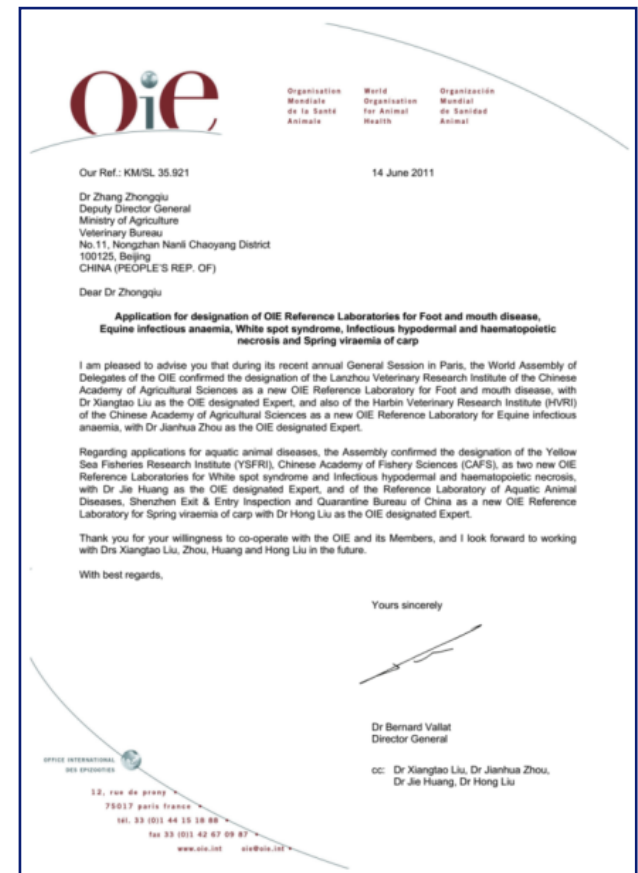
- *It is based at LVRI, CAAS;*
- *Found in 1958 (FMD research group);*
- *2002, Designated as National FMD Reference Laboratory (NFMDRL) by MOA (MARA), China;*
- *2011, Designated as WOA/China National Reference Laboratory for FMD.*



Prof. Xiangtao Liu



DG: Prof. Haixue Zheng



Foot and mouth disease (FMD): overview

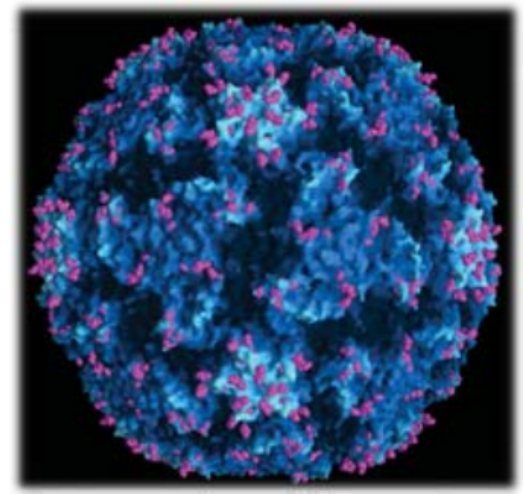
- It infects mammals such as cattle, sheep, goats and pigs, causing lesions on the feet and in the mouth.
- The disease is estimated to circulate in 77% of the global livestock population.
- It is an WOAHA-listed disease and must be reported to the Organisation
- Seven serotypes (A, O, C, SAT1, SAT2, SAT3, and Asia1), no cross-protection.



FMDV lesions



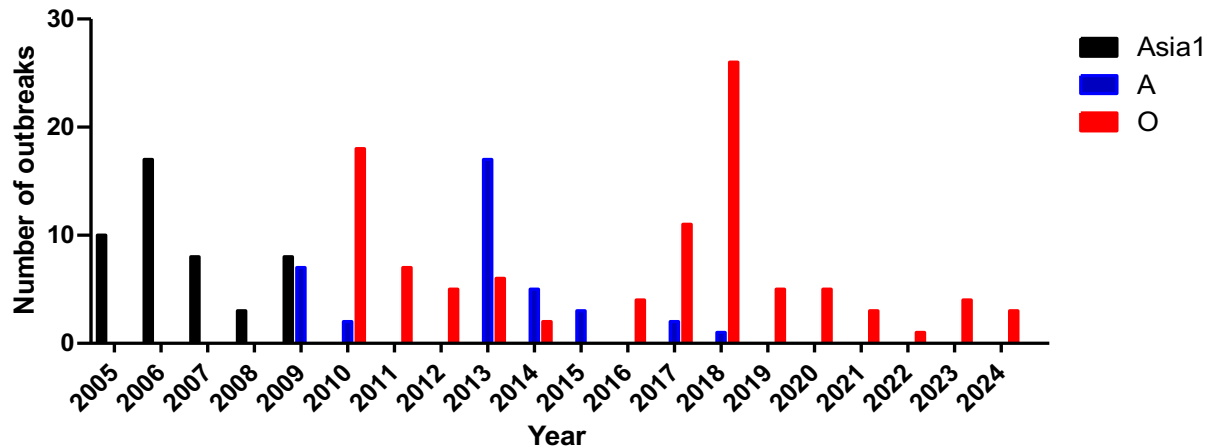
FMD pyre at a UK farm, 2001



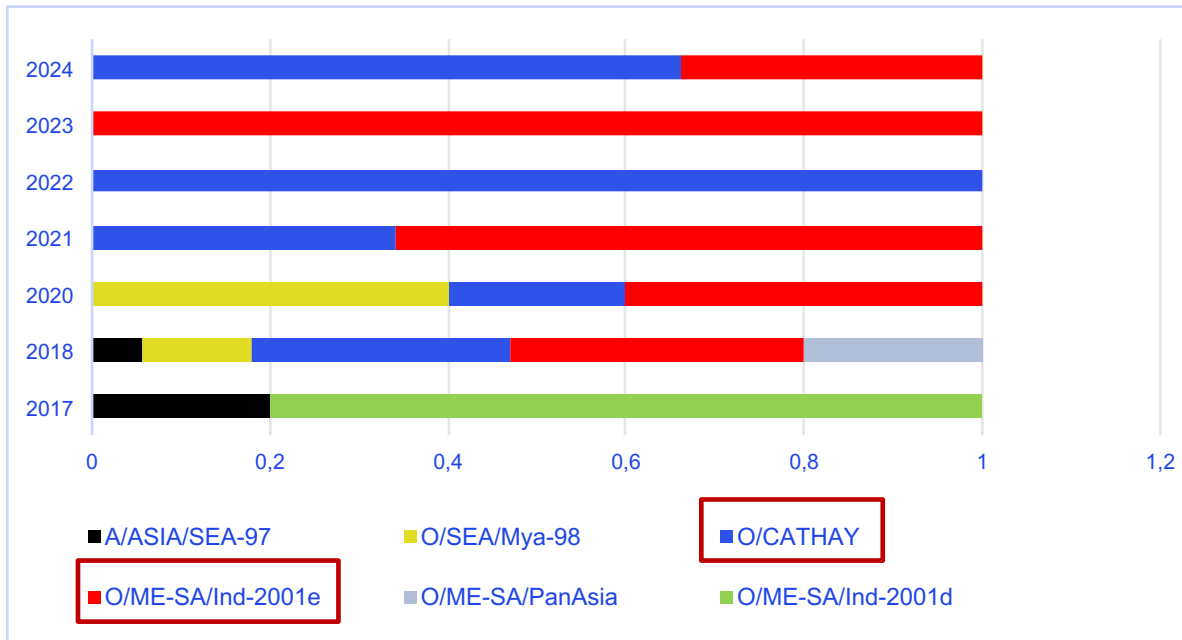
FMD particles

Outbreaks of foot and mouth disease can have serious economic consequences.

O/ME-SA/Ind-2001e is more prevalent in China

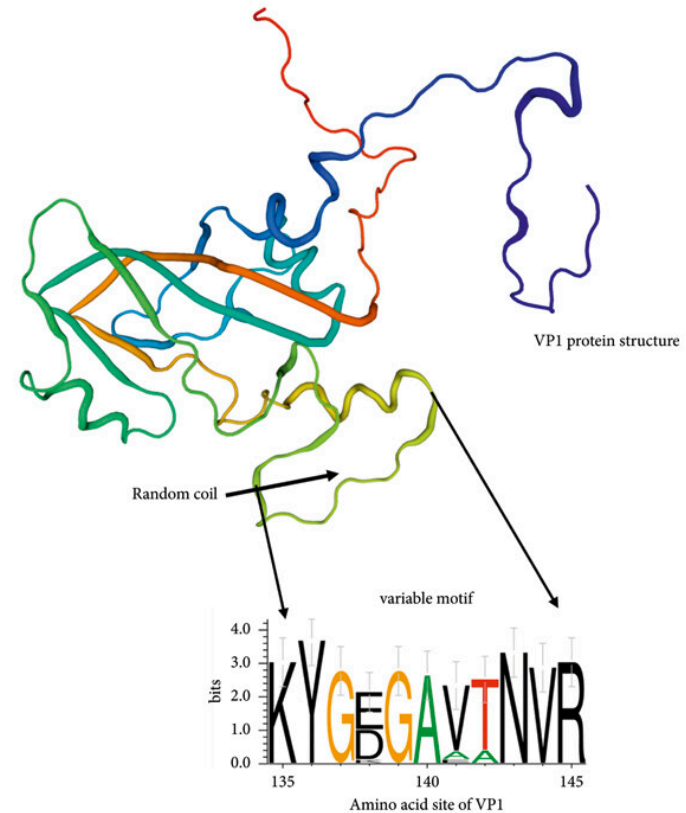
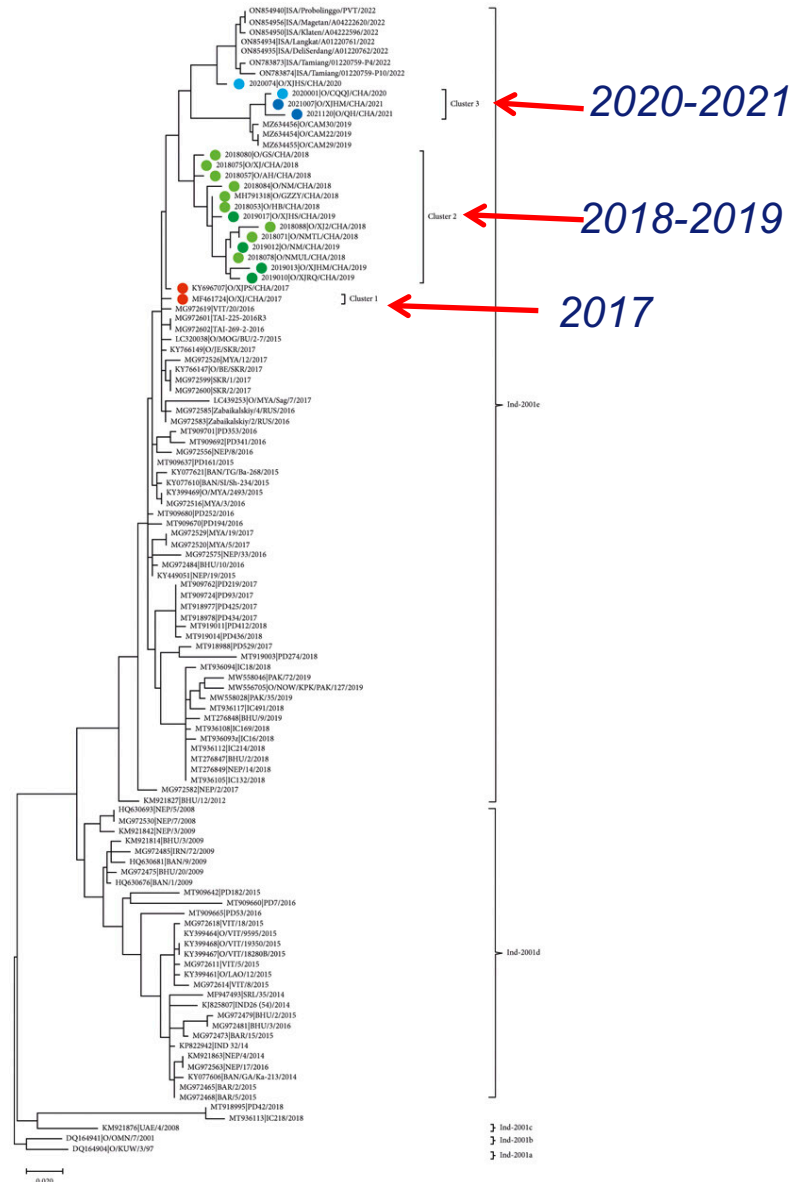


- Number of outbreaks in China;
- Distribution of causative serotypes



- Distribution of causative strains;
- Conclusion: O/ME-SA/Ind-2001e is one of dominant strains in China.

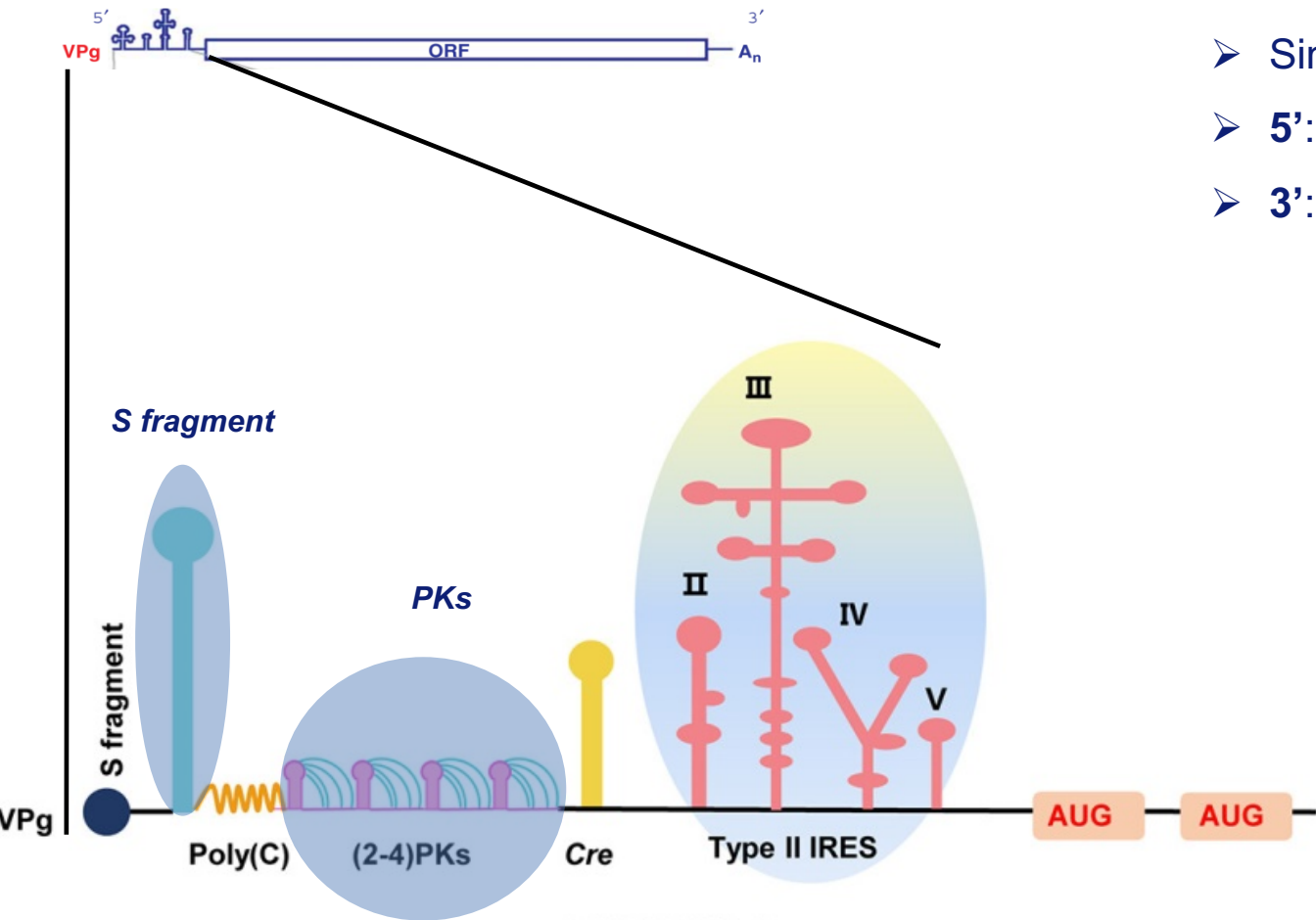
O/ME-SA/Ind-2001e in China between 2017 and 2021



Antigenic sites (B cell epitopes) in VP1

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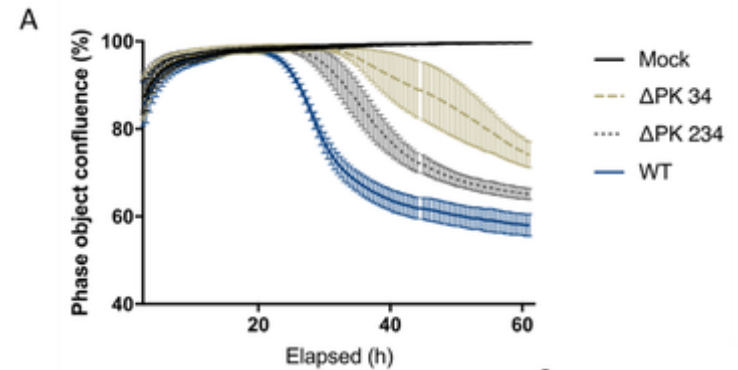
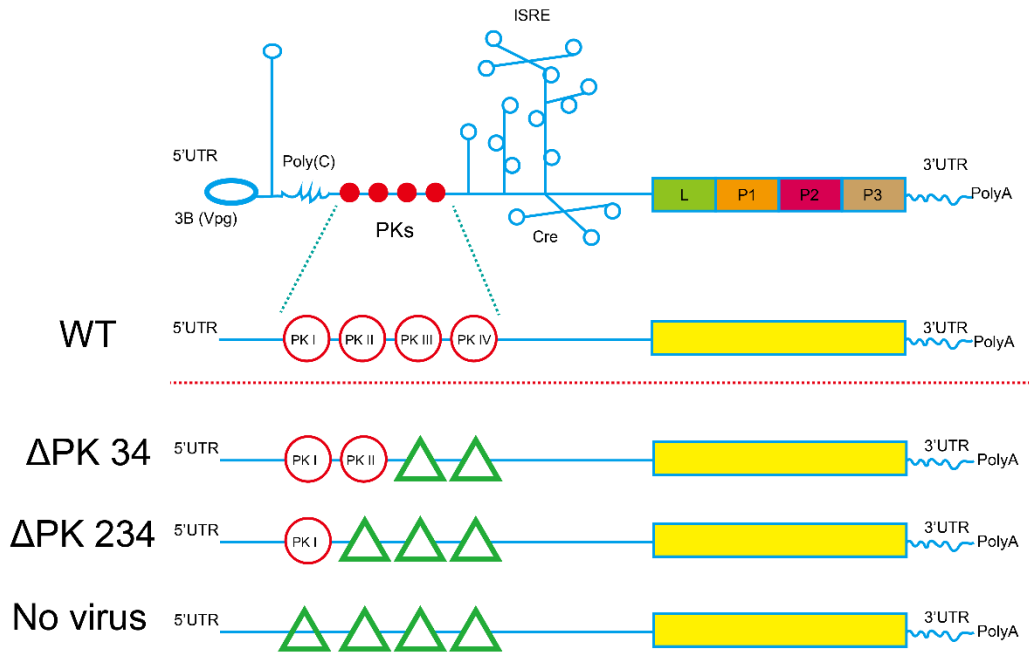
FMDV pseudoknots (PKs): determinants for FMDV replication



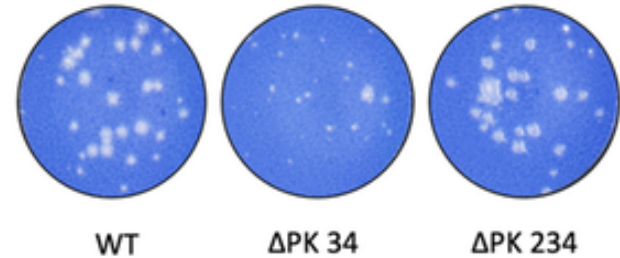
- Single-stranded RNA, 7-8 kb
- 5': covalently linked to VPg
- 3': poly(A)

For translation, the 40S ribosomal subunit binds not at the 5' end of the RNA, but internally at the IRES.

FMDV pseudoknots (PKs): determinants for FMDV replication



Cell confluence

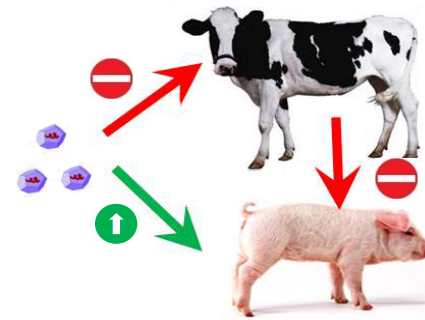
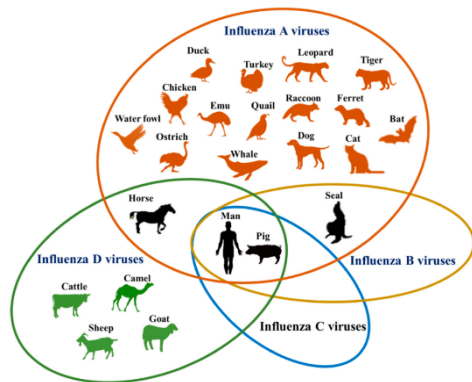


Plaque assay

The RNA pseudoknots in foot-and-mouth disease virus are dispensable for genome replication, but essential for the production of infectious virus.

FMDV pseudoknots (PKs): determinants for FMDV host tropism

- A 10-amino-acid deletion in the 3A protein that is responsible for the decreased pathogenicity of Cathay topotype FMDVs in bovines.
- In the pig-adapted Cathay topotype FMDVs, a 43-nt deletion in the PK region and the 3A deletion co-existed.
- An O/ME-SA/PanAsia lineage strain O/GD/CHA/2015 was isolated in China.
 1. Pig-adapted;
 2. 86-nt deletions in the PK regions;
 3. Intact 3A.

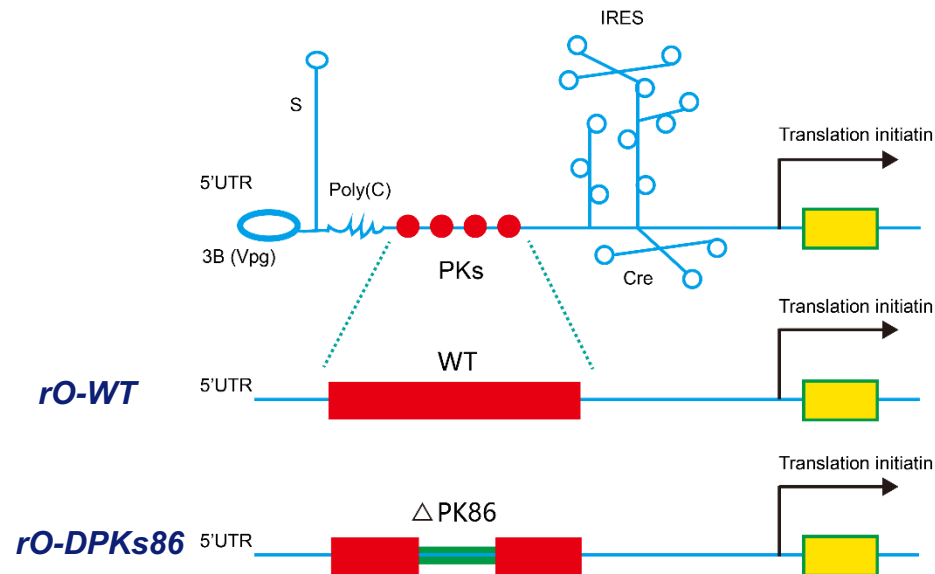


How the 86-nt deletion in the PK region affects viral tropism and virulence of foot and mouth disease virus.

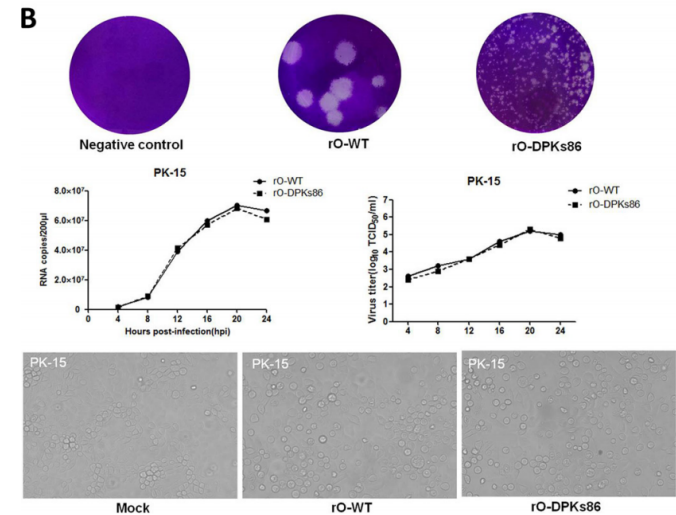
FMDV pseudoknots (PKs): determinants for FMDV host tropism

➤ A strain O/CHA/7/2011 was used as backbone.

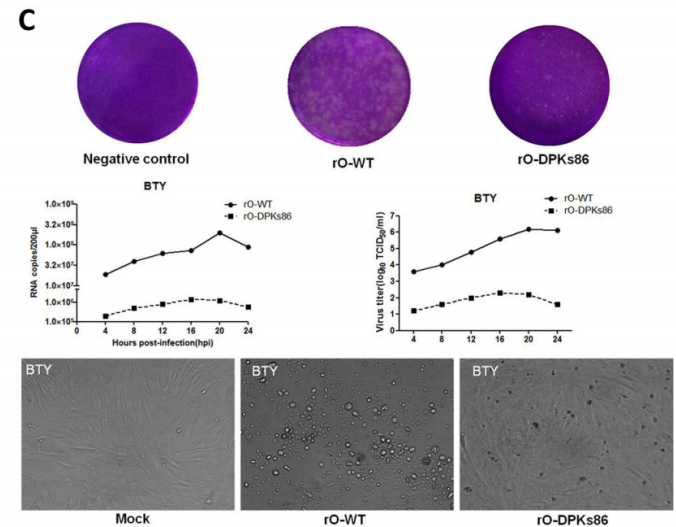
1. Good infections in pigs and cattle;
2. Intact PK regions;
3. Intact 3A.



Porcine cells



Bovine cells



An 86-nt deletions in the PK regions could not affect virus replication in porcine cells.

FMDV pseudoknots (PKs): determinants for FMDV host tropism

rO-WT



rO-DPKs86

rO-WT



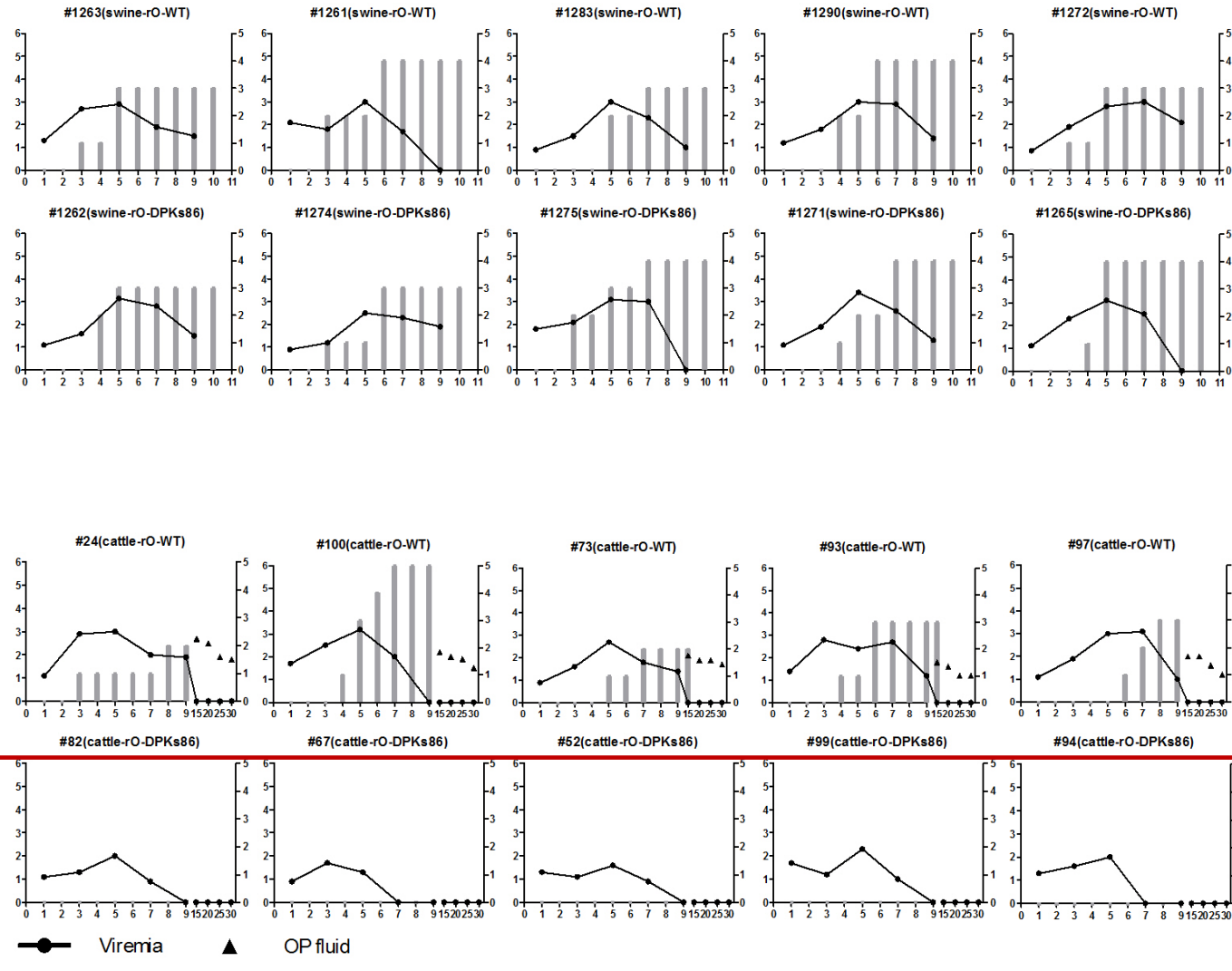
rO-DPKs86

Log₁₀RNA copies/200μL

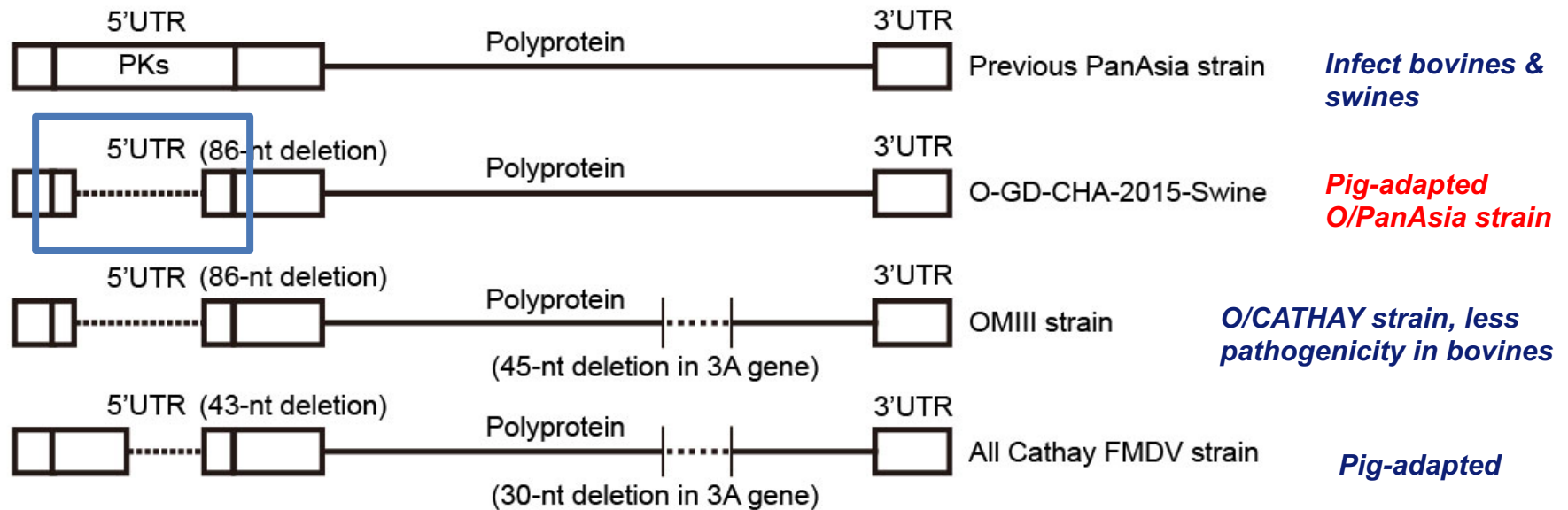
Log₁₀RNA copies/200μL

Clinical score

Clinical score



FMDV pseudoknots (PKs): determinants for FMDV host tropism



FMD vaccines at CAVET

The company is an exclusive manufacturer to produce all different kinds of FMD vaccines which was authorized by MARA, China



FMD Type O
Inactivated Vaccine
(Strain
O/MYA98/BY/2010)
(Domestic exclusive)



FMD Type O/A
Bivalent Inactivated
Vaccine



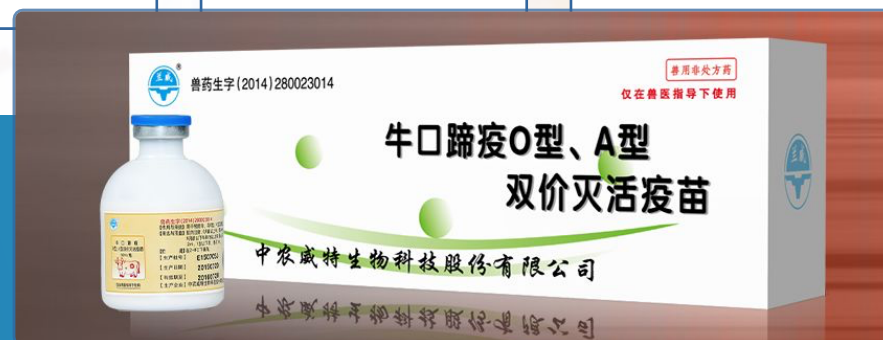
FMD Type O/Asia1
Bivalent Inactivated
Vaccine



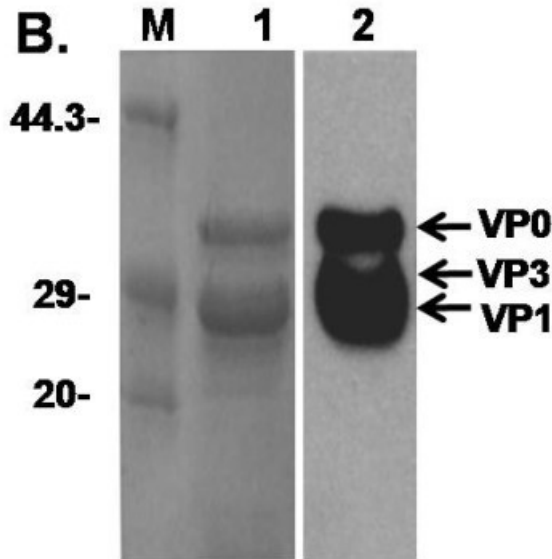
FMD Type
O/A/Asia1 Trivalent
Inactivated Vaccine



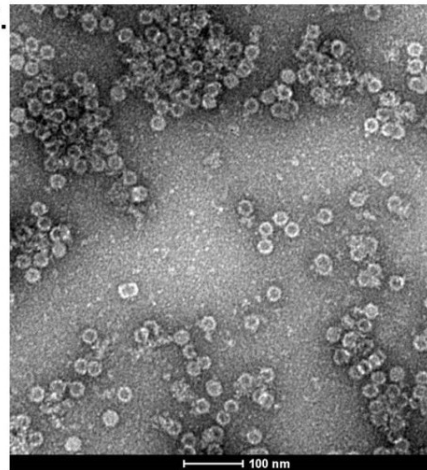
Swine FMD Type O/A
Bivalent Inactivated
Vaccine (Re-Strain
O/MYA98/JSCZ/2013
+Re-Strain A/WH/09)



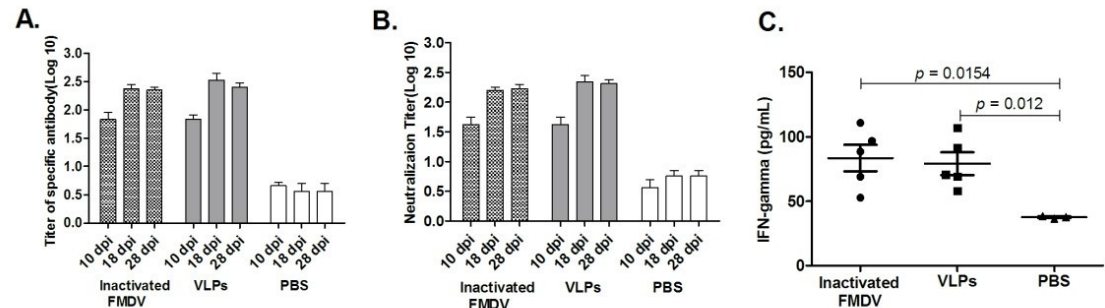
FMD virus-like-particle (VLP) vaccines in LVRI



SDS-PAGE (lane 1)
Western blot (lane 2)



Electron microscopy



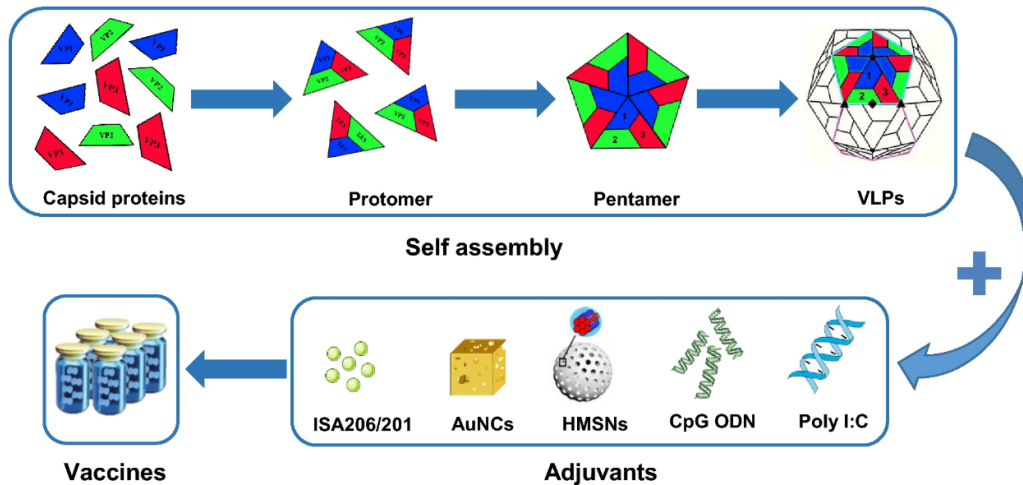
FMDV-specific immune response in pigs

Group	No	Neutralizing titer			Protection	Rate of protection
		9 dpi	16 dpi	21 dpi	10 dpc	
One dose	#4536	2.408	2.709	2.107	yes	100(5/5)
	#4572	2.107	2.408	2.408	yes	
	#4574	2.408	2.709	2.107	yes	
	#4590	2.107	2.408	2.408	yes	
	#4592	2.408	2.709	2.408	yes	
1/3 dose	#4501	1.806	1.806	1.806	yes	80(4/5)
	#4561	1.204	1.505	1.806	yes	
	#4575	1.806	2.107	2.107	yes	
	#4593	1.806	1.806	1.806	yes	
	#4597	1.204	1.204	1.505	no	
1/9 dose	#4534	1.505	1.505	1.806	no	40(2/5)
	#4563	1.505	1.505	1.204	yes	
	#4564	1.204	1.505	1.505	no	
	#4594	1.806	1.806	1.806	yes	
	#4598	1.204	1.505	1.505	no	
Healthy cattle	#4576	0.778	0.903	0.778	no	0(0/5)
	#4580	0.903	0.778	0.602	no	

The neutralizing titer and protection of cattle

FMD virus-like-particle (VLP) vaccines in LVRI

- *Virus-like particles vaccine is under progress.*



Virus-like particles vaccine

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Production license



Three Class I new veterinary drug certificates

2025 International Training Workshop

- *We need you.*

2025 International Training Workshop on Major Transboundary Animal Diseases (TAD) Diagnosis Technology :

- *Will be held in Lanzhou on 6th Sep – 20th Sep, 2025*
- *More than 20 positions*
- *No lecture fee;*
- *Free accomodation;*
- *Beautiful views along yellow river;*
- *Mouth-watering food.*



中国农业科学院兰州兽医研究所



感谢关注，感谢支持！