

保护 **动物** 安全
FOR ANIMAL SAFETY,
FOR HUMAN HEALTH
关爱 **人类** 健康



猪病毒性腹泻疫苗研究进展

Research progress on porcine viral diarrhea vaccine

肖 进

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猪病毒性腹泻疫苗研究进展

Research progress on porcine viral diarrhea vaccine



猪病毒性腹泻相关检测方法建立 Establishment of Detection Methods for Porcine Viral Diarrhea



一、猪病毒性腹泻病原及流行情况

I. Pathogen and Epidemic of Porcine Viral

Science-driven solutions[®]

Diarrhea

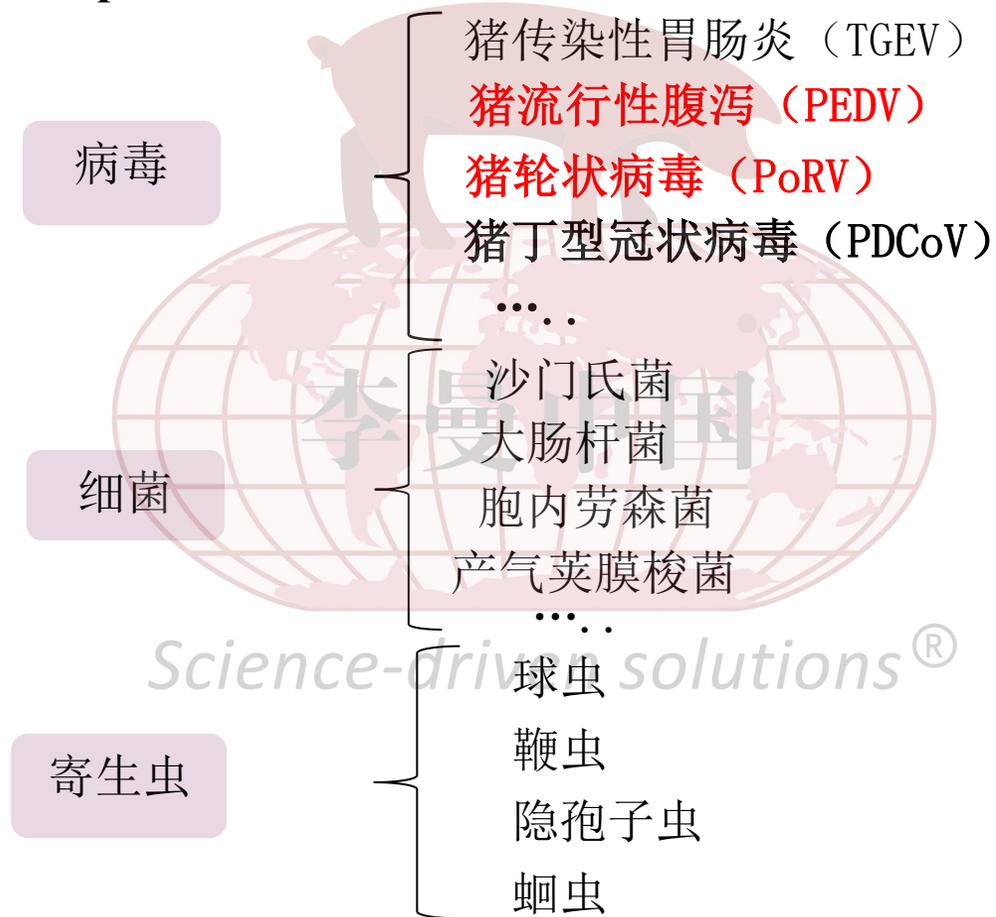
一、猪病毒性腹泻相关病原及流行情况

I. Relevant pathogens and epidemic situation of porcine viral diarrhea

腹泻类疫病在非瘟发生前后一直是行业聚焦的热点，临床诱因复杂

Diarrheal diseases have always been a hot topic in the industry before and after the occurrence of African swine fever, with complex clinical causes

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一、猪病毒性腹泻相关病原及流行情况

I. Relevant pathogens and epidemic situation of porcine viral diarrhea

近三年病毒性腹泻样品阳性率

Positive rate of viral diarrhea samples in recent three years

样品	2023年	2024年	2025年上半年
猪流行性腹泻 (PEDV)	28.46%	25.42%	43.42%
猪轮状病毒 (PoRV)	61.04%	72.74%	58.64%
猪丁型冠状病毒 (PDCoV)	4.55%	8.17%	5.17%

近三年病毒性腹泻场家阳性率

Positive rate of viral diarrhea in farms in recent three years

样品	2023年	2024年	2025年上半年
猪流行性腹泻 (PEDV)	36.88%	32.72%	41.62%
猪轮状病毒 (PoRV)	80.20%	70.97%	60.64%
猪丁型冠状病毒 (PDCoV)	6.68%	8.03%	5.26%

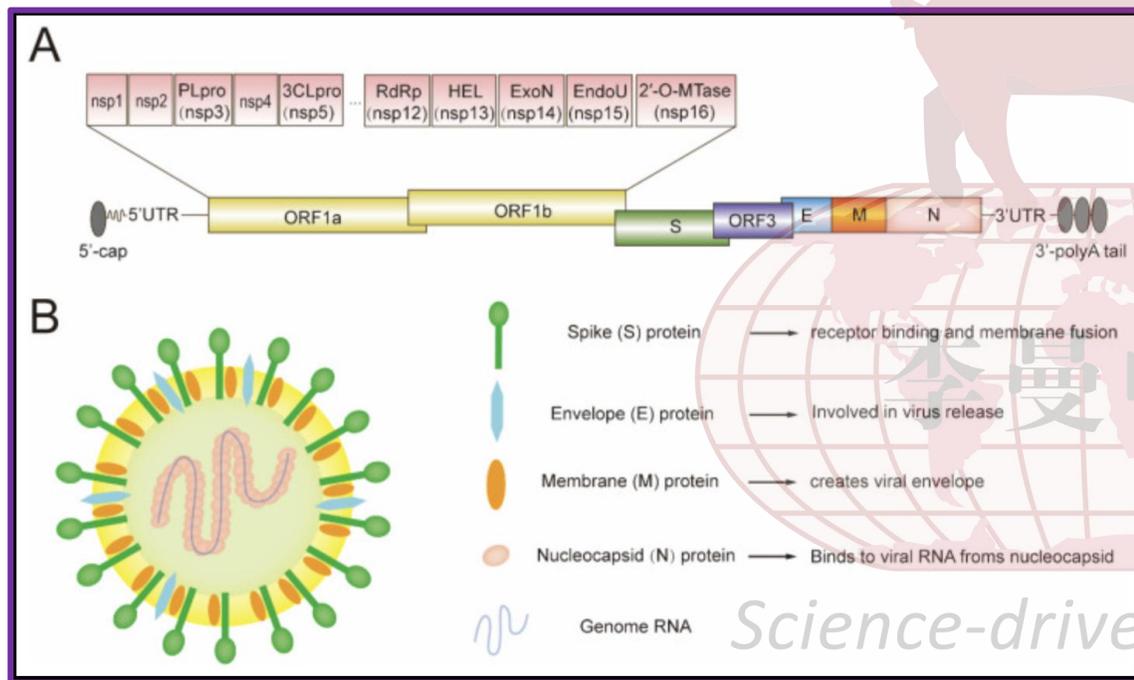
数据来源：中牧研究院诊断中心

一、猪病毒性腹泻相关病原及流行情况--PEDV

I. Relevant pathogens and epidemic situation of porcine viral diarrhea - PEDV

猪流行性腹泻病毒 (PEDV)

Porcine Epidemic Diarrhea Virus (PEDV)

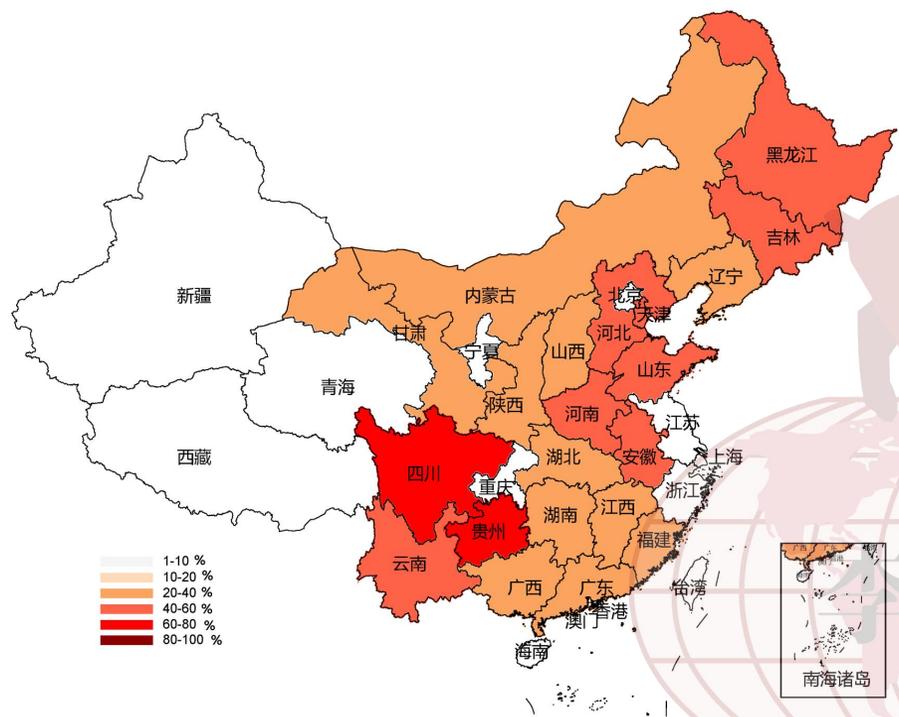


(Li X, et al. Genes (Basel). 2024)

- ◆ 冠状病毒科、 α 冠状病毒属，有囊膜单股正链 RNA
- ◆ N保守，用于鉴别诊断；S 蛋白产生中和抗体
- ◆ TP二联、三联活疫苗，TP二联灭活疫苗众多
- ◆ 流行毒株众多：G1a、G1b、S-indel、G2a、G2b、G2c，防控形势复杂
- ◆ Coronaviridae, α -coronavirus genus, with envelope and single-stranded positive-sense RNA
- ◆ N is conservative and used for differential diagnosis; S protein produces neutralizing antibodies
- ◆ TP combined and triple live vaccines, as well as TP combined inactivated vaccines are numerous
- ◆ There are many prevalent strains: G1a, G1b, S-indel, G2a, G2b, G2c, and the prevention and control situation is complex

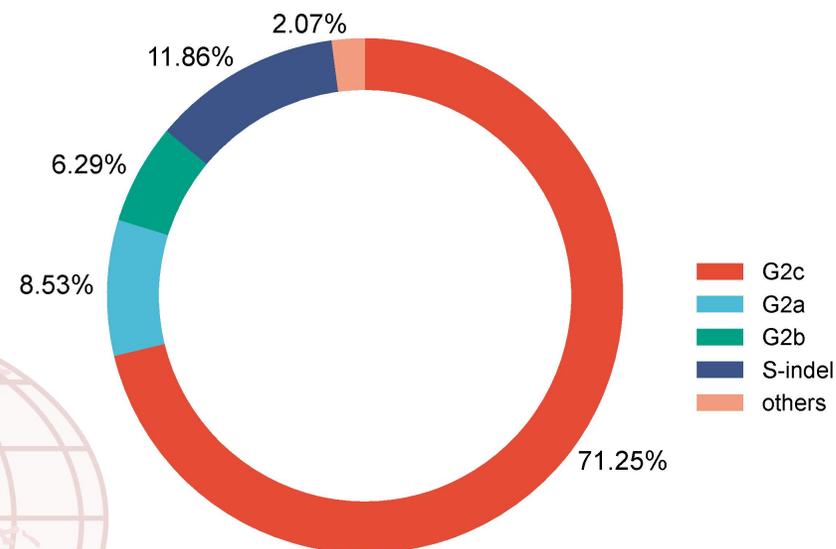
一、猪病毒性腹泻相关病原及流行情况--PEDV

I. Porcine viral diarrhea-related pathogens and epidemic situation - PEDV



PEDV 检测阳性流行分布图

Epidemic distribution map of PEDV positive detection



PEDV 不同亚型分布图

Distribution of different PEDV subtypes

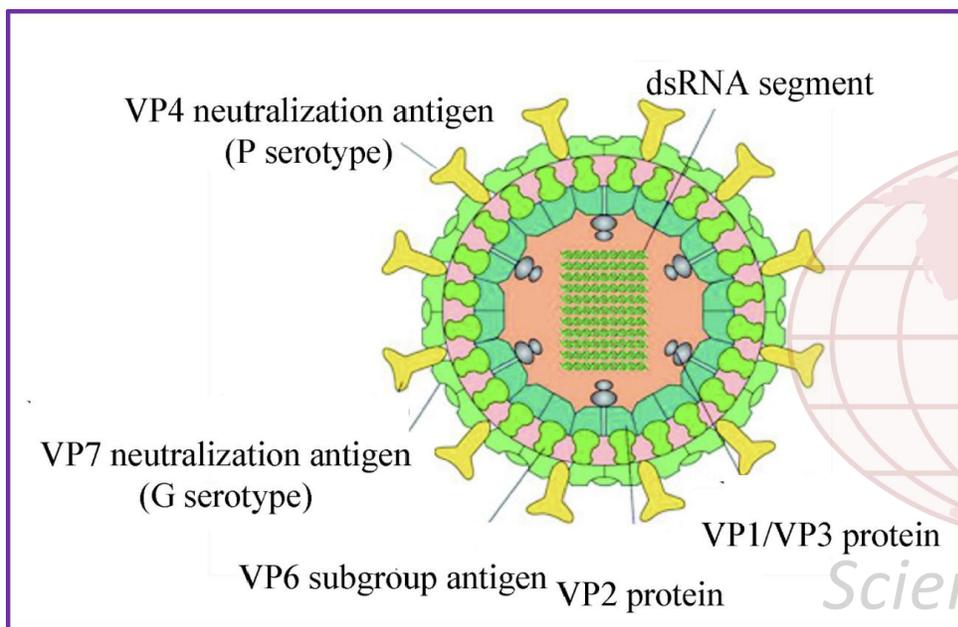
PEDV在我国广泛流行，阳性率在21.85%~63.13%间，其中四川与贵州阳性率高达63.13%和62.33%。遗传进化分析显示，目前主要流行毒株为G2c（71.25%）、G2a（8.53%）、G2b（6.29%）、S-indel（11.86%）。

PEDV is widely prevalent in China, with positive rates ranging from 21.85% to 63.13%, with Sichuan and Guizhou having the highest positive rates of 63.13% and 62.33%, respectively. Genetic evolution analysis shows that the currently predominant strains are G2c (71.25%), G2a (8.53%), G2b (6.29%), and S-indel (11.86%).

一、猪病毒性腹泻相关病原及流行情况--PoRV

I. Relevant pathogens and epidemic situation of porcine viral diarrhea - PoRV

猪轮状病毒 (PoRV) Porcine Rotavirus (PoRV)

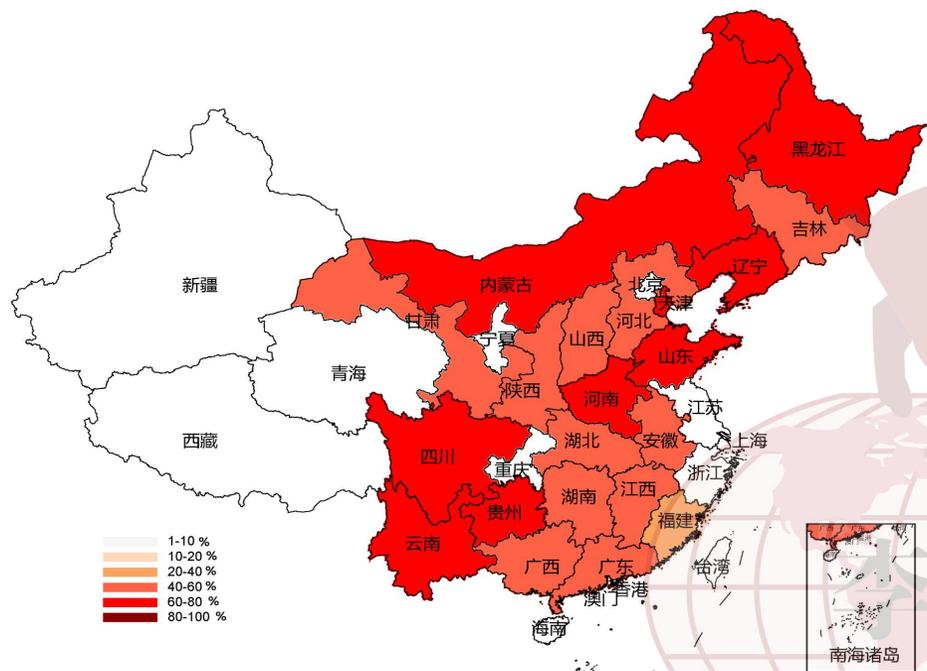


(Ryu W S, et al. Amsterdam: Elsevier Inc. 2017)

- ◆ 呼肠孤病毒科、轮状病毒属，无囊膜11节段双链 RNA 病毒
- ◆ VP6 蛋白：核衣壳蛋白，保守性，划分A-F共6个血清群
- ◆ A群PoRV：42个G基因型 (VP7) ， 58个P基因型 (VP4)
- ◆ 多血清型、多基因型、易突变，基因型间交叉保护差
- ◆ 国外疫苗：G4、5、9三联活疫苗；国内PEDV/TEGV/PoRV三联活疫苗
- ◆ Reovirus family, Rotavirus genus, non-enveloped 11-segment double-stranded RNA virus
- ◆ VP6 protein: nucleocapsid protein, conserved, divided into 6 serogroups A-F
- ◆ Group A PoRV: 42 G genotypes (VP7), 58 P genotypes (VP4)
- ◆ Multiple serotypes, multiple genotypes, prone to mutation, poor cross-protection between genotypes
- ◆ Foreign vaccine: G4, 5, 9 trivalent live vaccine; domestic PEDV/TEGV/PoRV trivalent live vaccine

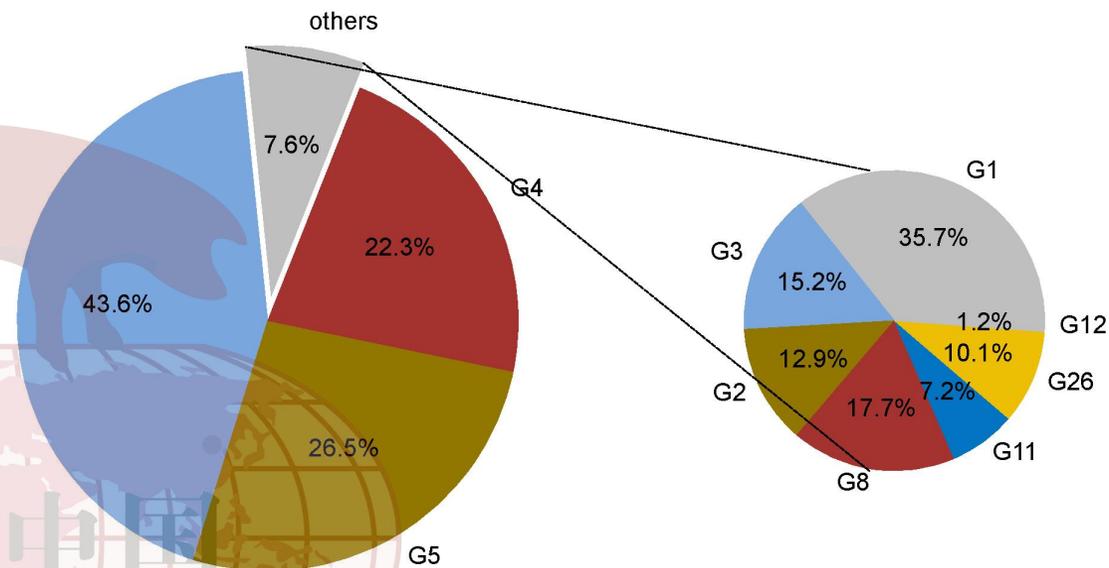
一、猪病毒性腹泻相关病原及流行情况--PoRV

I. Relevant pathogens and epidemic situation of porcine viral diarrhea - PoRV



PoRV 检测阳性流行分布图

Epidemic distribution map of positive PoRV detection



PoRV 不同亚型分布图

Distribution of different PoRV subtypes

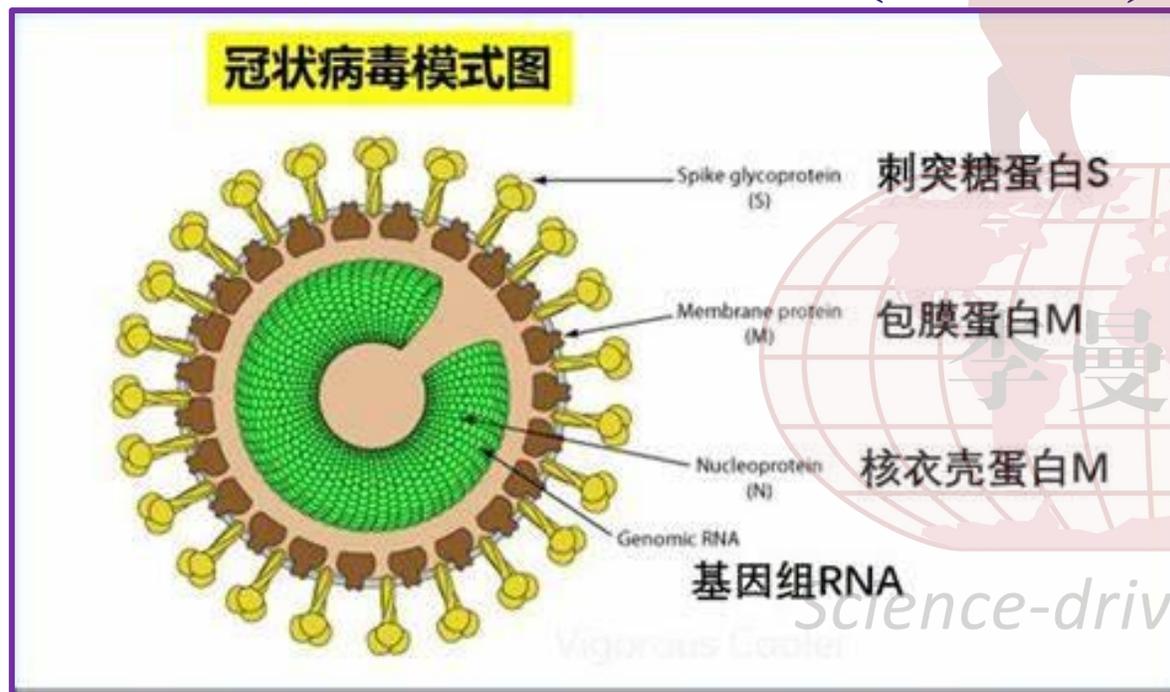
PoRV在猪场广泛流行，不同地区阳性率在37.98%~79.54%间。PoRV VP7基因测序分析表明G9（43.60%）、G5（26.50%）、G4（22.30%）为主要流行亚型，此外，还监测到G1、G2、G3、G8、G26等亚型毒株。

PoRV is widely prevalent in pig farms, with positive rates ranging from 37.98% to 79.54% in different regions. Sequencing analysis of PoRV VP7 gene indicates that G9 (43.60%), G5 (26.50%), and G4 (22.30%) are the predominant subtypes. In addition, G1, G2, G3, G8, G26, and other subtype strains have also been detected.

一、猪病毒性腹泻相关病原及流行情况--PDCoV

I. Relevant pathogens and epidemic situation of porcine viral diarrhea - PDCoV

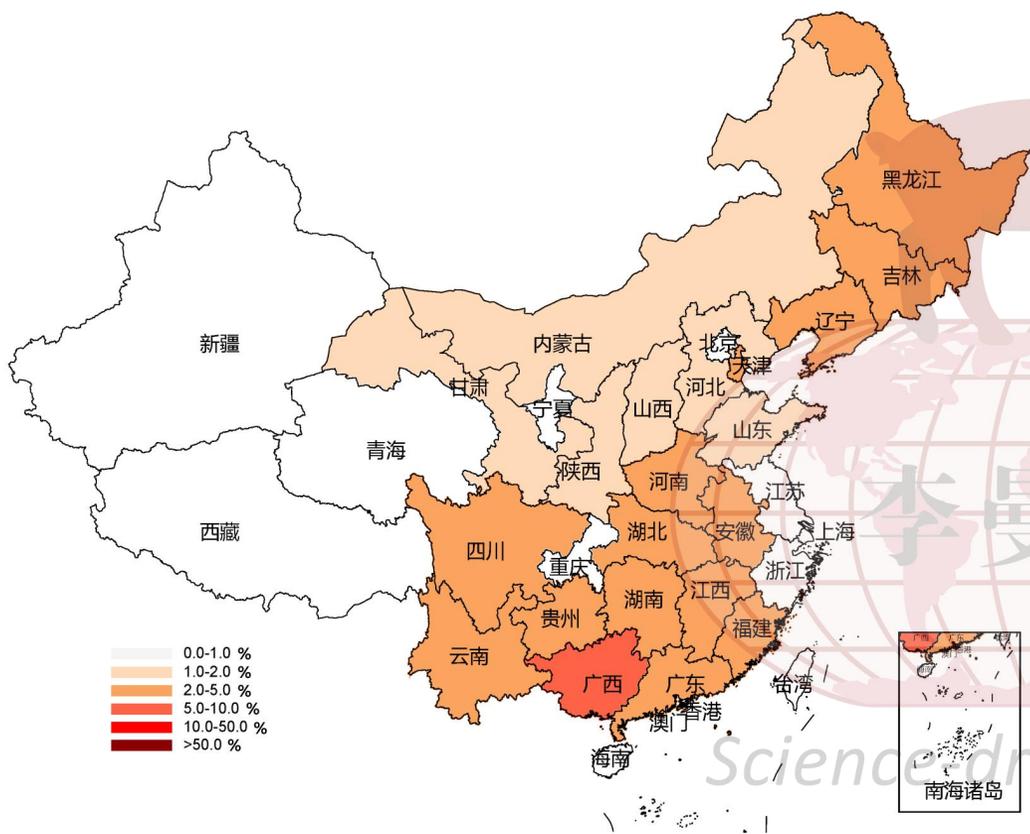
猪德尔塔冠状病毒 (PDCoV) Porcine Delta Coronavirus (PDCoV)



- ◆ 套式病毒目、冠状病毒科、 δ 冠状病毒属
- ◆ 有囊膜的单股正链 RNA 病毒
- ◆ N 蛋白：核衣壳蛋白，高度保守，诊断抗原
- ◆ S 蛋白：纤突蛋白，中和抗原
- ◆ 灭活单苗、三联灭活疫苗；免疫原性好，易防控
- ◆ Nidovirales, Coronaviridae, Delta coronaviruses
- ◆ enveloped mononegaviruses
- ◆ N protein: nucleocapsid protein, highly conserved, diagnostic antigen
- ◆ S protein: spike protein, neutralizing antigen
- ◆ Inactivated single vaccine, trivalent inactivated vaccine; good immunogenicity, easy to prevent and control

一、猪病毒性腹泻相关病原及流行情况--PDCoV

I. Relevant pathogens and epidemic situation of porcine viral diarrhea - PDCoV



PDCoV 检测阳性流行分布图

Epidemic distribution map of PDCoV positive cases

PDCoV在南方大部分地区呈现流行趋势，多与PoRV、PEDV呈现双重感染或多重感染，混合感染情况比较复杂，因此对于腹泻类疫病的防控一定要精准检测，这样才能做到精准免疫和精准防控。

PDCoV is prevalent in most regions of the south, often co-occurring with PoRV and PEDV in dual or multiple infections. The situation of mixed infections is complex, so precise detection is essential for the prevention and control of diarrheal diseases. Only in this way can precise immunization and prevention and control be achieved.

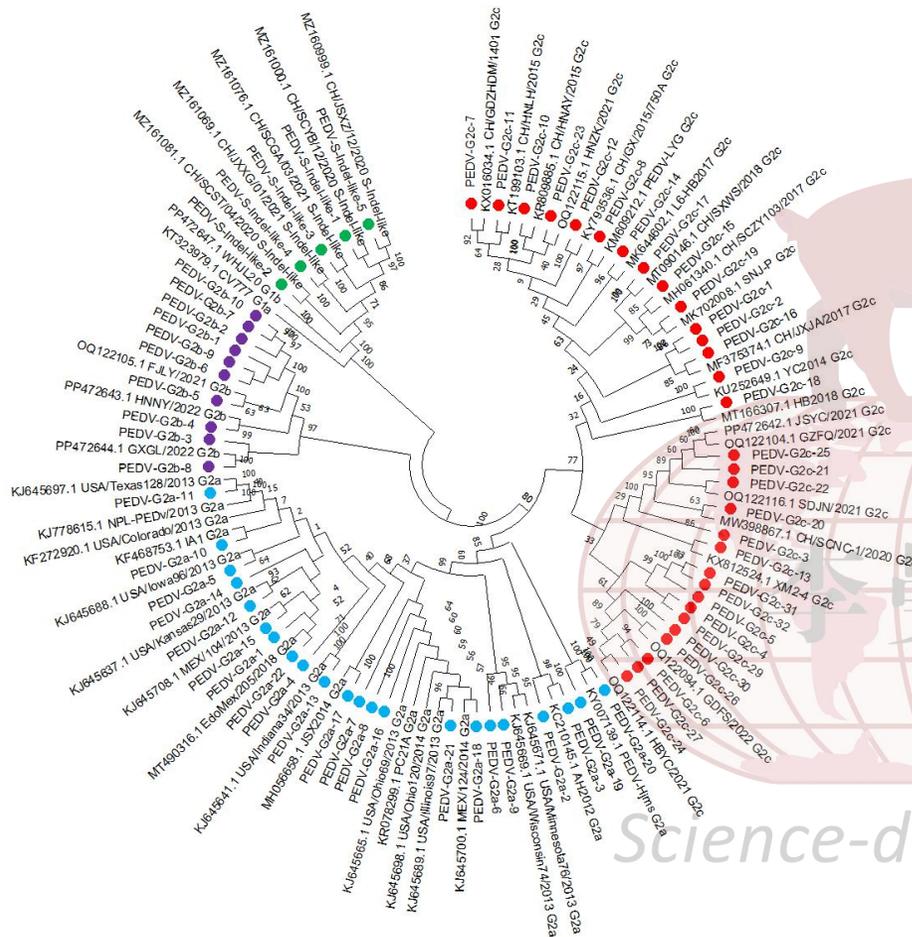
二、流行毒株分离及攻毒模型建立

II. Isolation of epidemic strains and establishment of challenge model

- 1、PEDV流行毒株分离 1. Isolation of PEDV epidemic strains
- 2、PEDV流行毒株攻毒模型建立 2. Establishment of PEDV epidemic strain challenge model
- 3、PoRV流行毒株分离 3. Isolation of PoRV epidemic strains
- 4、PoRV流行毒株攻毒模型建立 4. Establishment of PoRV epidemic strain challenge model

Science-driven solutions®

1、PEDV流行毒株分离1. Isolation of PEDV epidemic strains



● S-Indel-like-1~S-Indel-like-5

● G2a-1~G2a-22

● G2b-1~G2b-10

● G2c-1~G2c-32

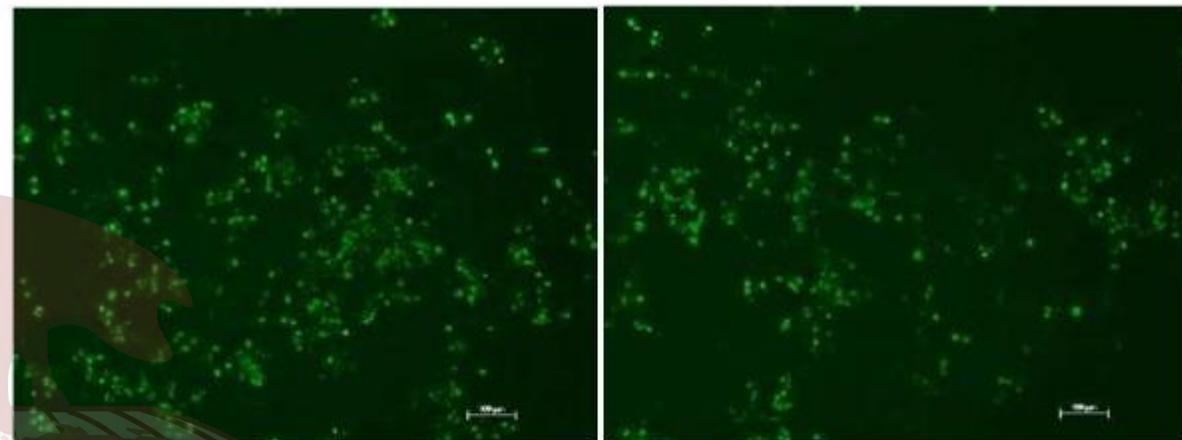
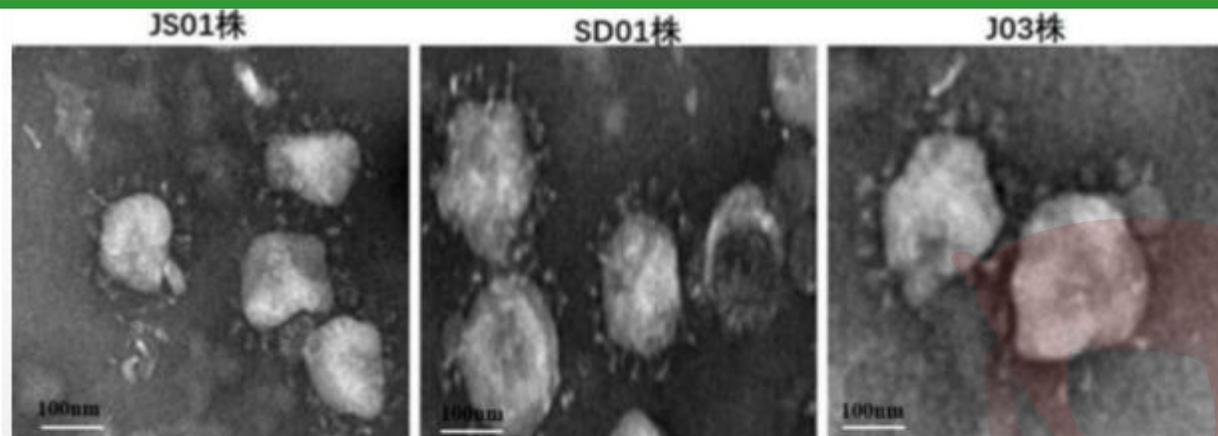
G2c流行广泛，感染后排毒期延长达40-60天，远超G2b的21-30天。其次，临床症状更为复杂，感染母猪流产率出现上升，尤其是在妊娠早期至中期（20-70天），流产率可达1-10%。

G2c is widespread, and the post-infection detoxification period can last up to 40-60 days, significantly longer than the 21-30 days of G2b. Additionally, the clinical symptoms are more complex, and the abortion rate among infected sows has increased, especially during the early to mid-pregnancy period (20-70 days), with abortion rates reaching 1-10%.

基于 PEDV S1 基因绘制系统发育进化树

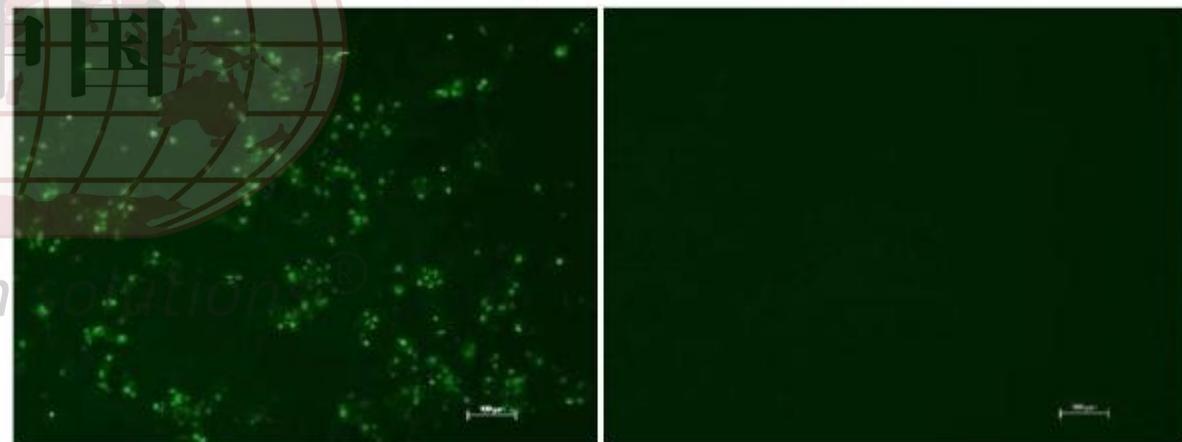
Drawing a phylogenetic tree based on PEDV S1 gene

1、PEDV流行毒株分离1. Isolation of PEDV epidemic strains



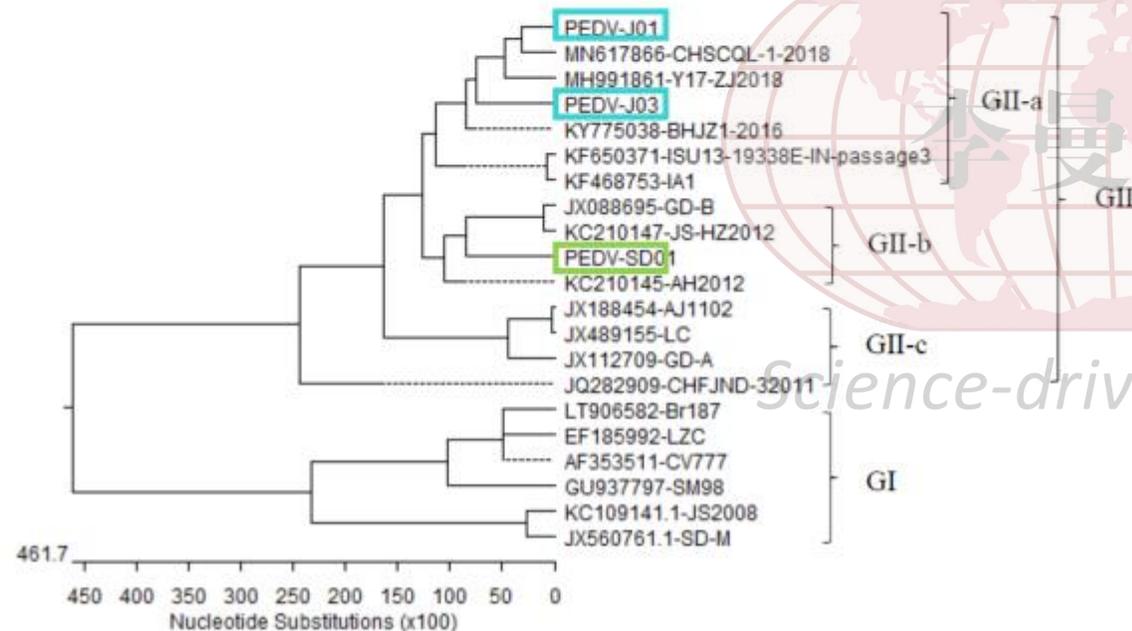
J01 株感染细胞 (100×)

SD01 株感染细胞 (100×)



J03 株感染细胞 (100×)

正常细胞对照组 (100×)



1、PEDV流行毒株分离1. Isolation of PEDV epidemic strains

PEDV-S蛋白核心中和表位：COE（aa 499-638）、SS2（aa 748-755）、SS6（aa 764-771）、C端中和表位（aa 1368-1374）。这些表位氨基酸突变会导致免疫原性变化，发生免疫逃逸、免疫失败。The core neutralizing epitopes of PEDV-S protein are COE (aa 499-638), SS2 (aa 748-755), SS6 (aa 764-771), and the C-terminal neutralizing epitope (aa 1368-1374). Mutations in these epitope amino acids can lead to changes in immunogenicity, resulting in immune evasion and immune failure.

Domain	COE												SS6								
Strains	499	502	504	520	524	539	552	566	597	606	608	634	636	767	768	769	770	771	772	773	774
G1a-CV777	I	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-SX-Iqak-250224	T	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-TSbl-250121	I	V	L	S	H	L	S	K	S	H	D	P	E	S	Q	S	G	Q	V	K	I
PEDV-AHhf-250213	I	V	Q	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-HBzjk-250320	I	V	L	S	H	L	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-HNhx-250210	I	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G1b-1	I	V	L	A	H	F	T	K	G	Y	E	P	Q	L	Q	D	G	Q	V	K	I
PEDV-G1b-2	I	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G1b-3	I	V	L	A	H	F	T	K	G	Y	E	P	Q	L	Q	D	G	Q	V	K	I
PEDV-G2a-1	T	V	L	A	H	F	S	N	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2a-2	T	V	L	A	H	F	S	N	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2a-3	I	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2a-4	I	V	P	S	H	F	S	K	S	Y	D	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2b-1	T	V	L	A	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2b-2	T	V	L	A	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2b-3	T	V	L	A	L	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2c-1	I	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I
PEDV-G2c-2	I	V	L	S	H	F	S	K	S	Y	E	P	E	S	Q	S	G	Q	V	K	I

2、PEDV G2c 攻毒模型建立

2. Establishment of PEDVG2c challenge model

口服 P5 5×10^6 TCID₅₀ 病毒液

28-35日龄仔猪

Oral administration of P5 5×10^6 TCID₅₀ virus solution to 28-35 day-old piglets

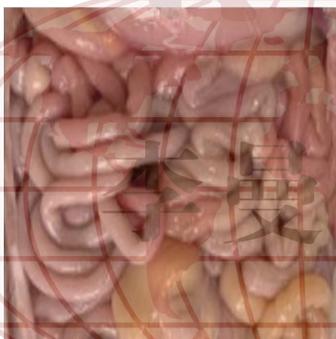
PEDV-G2c-5

PEDV-G2c-6

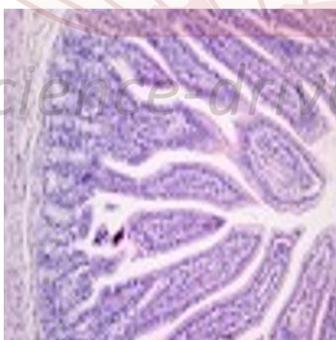
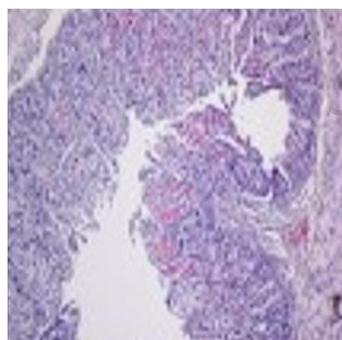
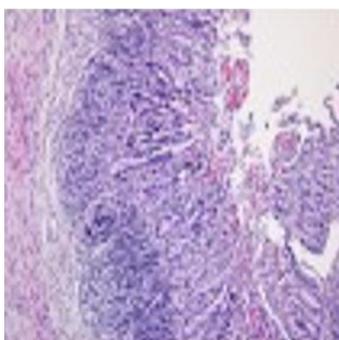
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临床症状

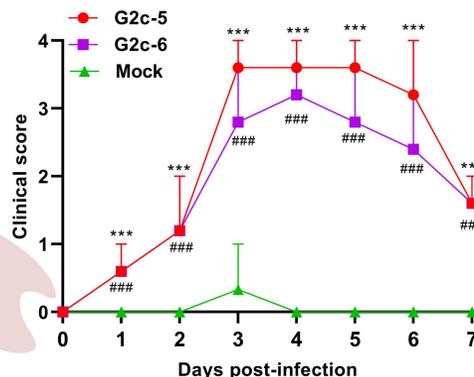


剖检变化

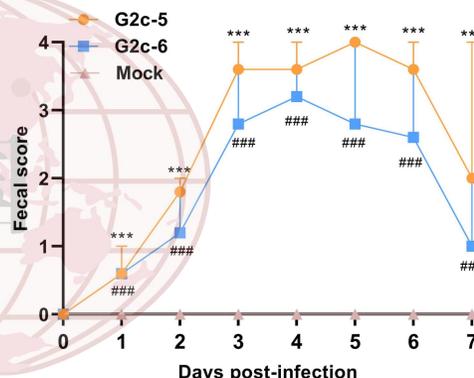


组织病理

临床评分



腹泻评分

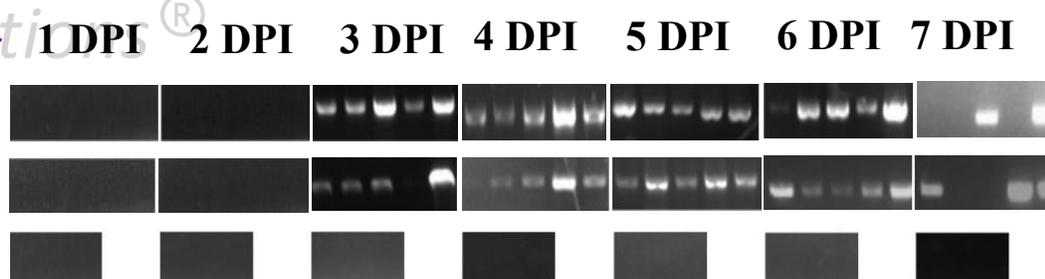


排毒情况

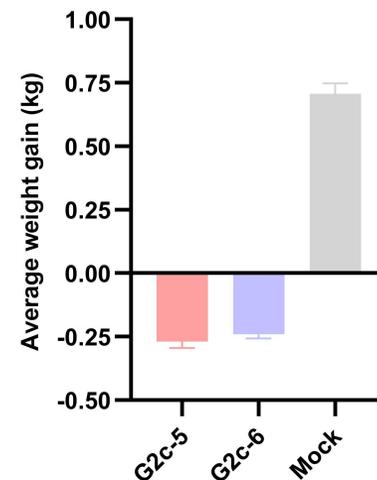
G2c-5

G2c-6

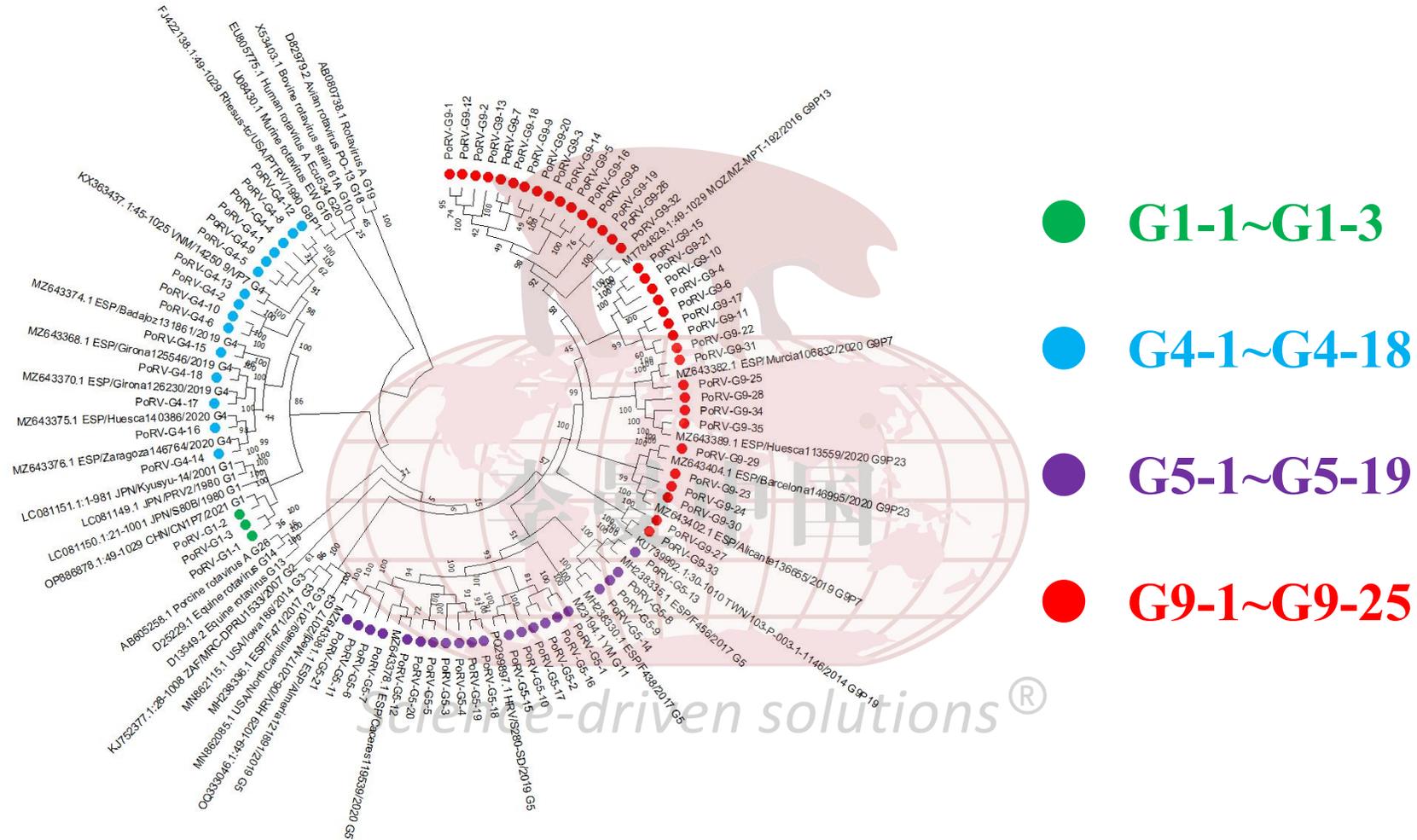
对照组



平均日增重



3、PoRV流行毒株分离3. Isolation of prevalent PoRV strains



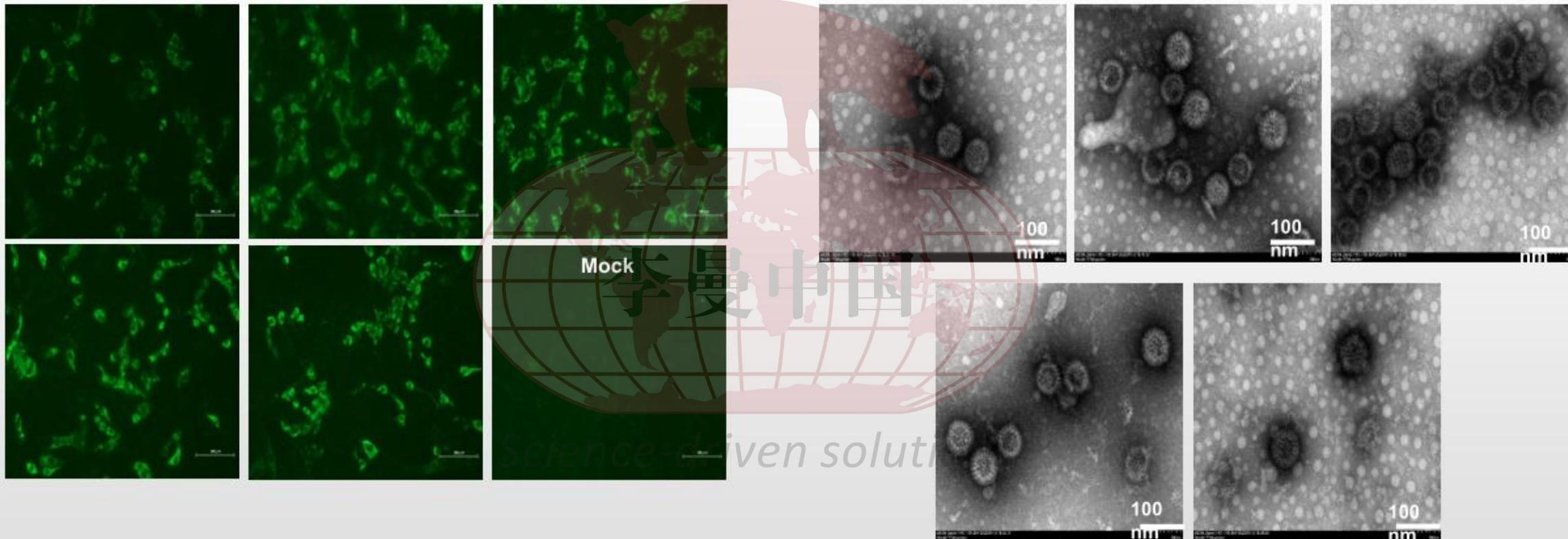
基于 PoRV VP7 基因绘制系统发育进化树

Construction of Phylogenetic Tree Based on Porcine Rotavirus VP7 Gene

3、PoRV流行毒株分离3. Isolation of PoRV epidemic strains

目前，中牧研究院已分离鉴定几十株轮状病毒，覆盖主要流行基因型G3、G4、G5、G9、G11等。

Currently, the CAHIC Research Institute has successfully isolated and identified dozens of rotavirus strains, encompassing the major prevalent genotypes G3, G4, G5, G9, and G11.



猪轮状病毒分离株间接免疫荧光检测

猪轮状病毒分离株病毒粒子电镜观察

4、PoRV G9攻毒模型建立

4. Establishment of PoRV G9 challenge model

口服 P5 5×10^8 TCID₅₀ 病毒液

28-35日龄仔猪

Oral administration of P5 5×10^8 TCID₅₀ virus solution to 28-35 day-old piglets

PoRV-G9-3

PoRV-G9-4

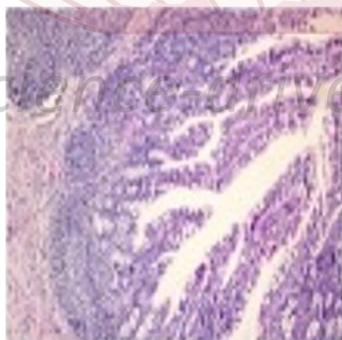
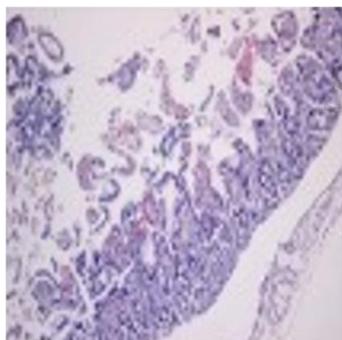
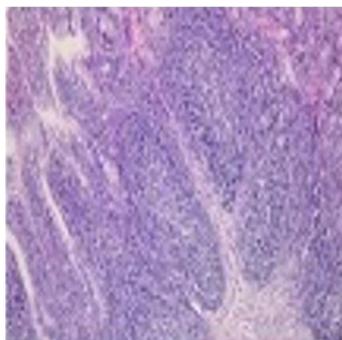
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临床症状

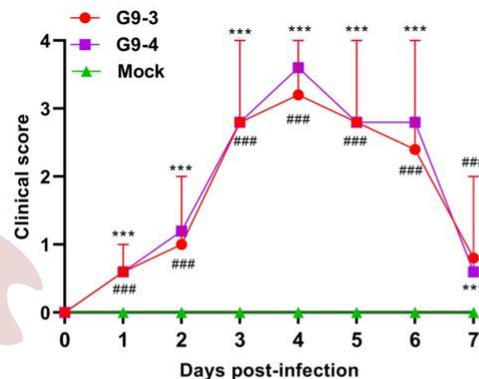


剖检变化

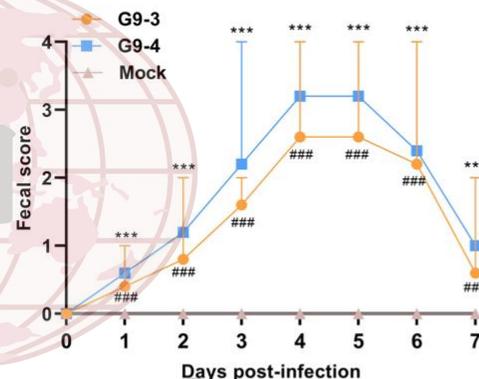


组织病理

临床评分



腹泻评分

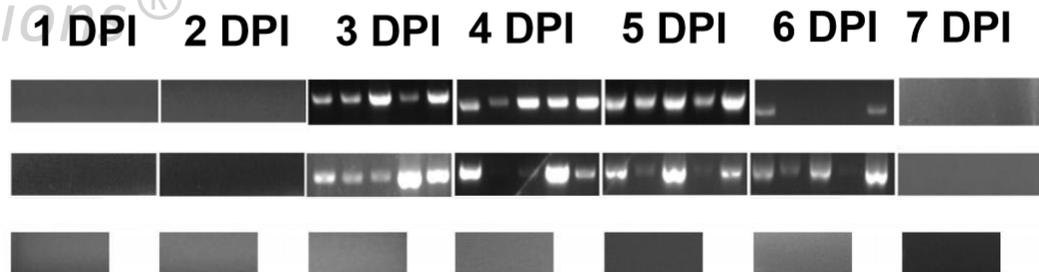


排毒情况

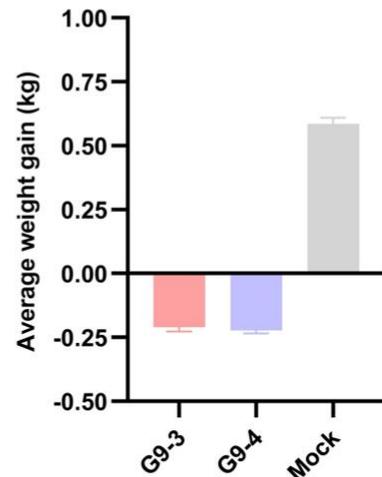
G9-3

G9-4

对照组



平均日增重



三、猪病毒性腹泻疫苗研究进展

III. Research progress of porcine viral diarrhea vaccine

1、PEDV灭活疫苗工艺研究

1. Research on the process of PEDV inactivated vaccine

2、PEDV灭活疫苗效力评价

2. Efficacy evaluation of PEDV inactivated vaccine

3、PEDV亚单位疫苗研究

3. Research on PEDV subunit vaccine

4、PoRV灭活疫苗工艺研究

4. Research on the process of PoRV inactivated vaccine

5、PoRV灭活疫苗效力评价

5. Efficacy evaluation of PoRV inactivated vaccine

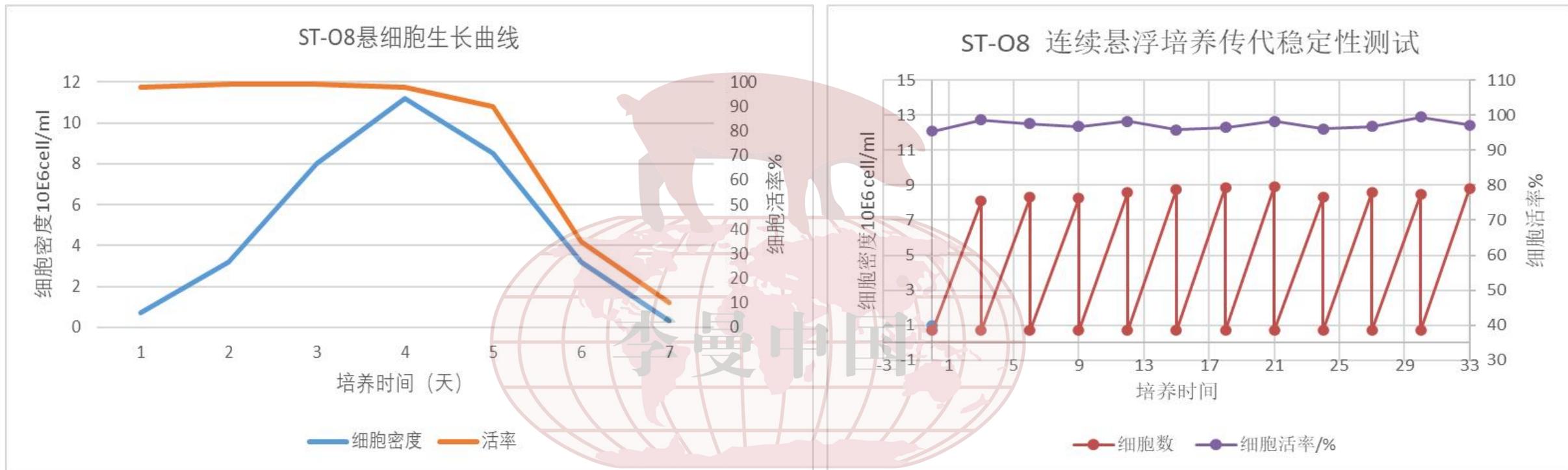
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1、PEDV灭活疫苗工艺研究—易感细胞系悬浮驯化

1. Research on the process of PEDV inactivated vaccine - Suspension domestication of susceptible cell lines

ST-O贴壁细胞悬浮驯化 ST-O adherent cell suspension acclimation



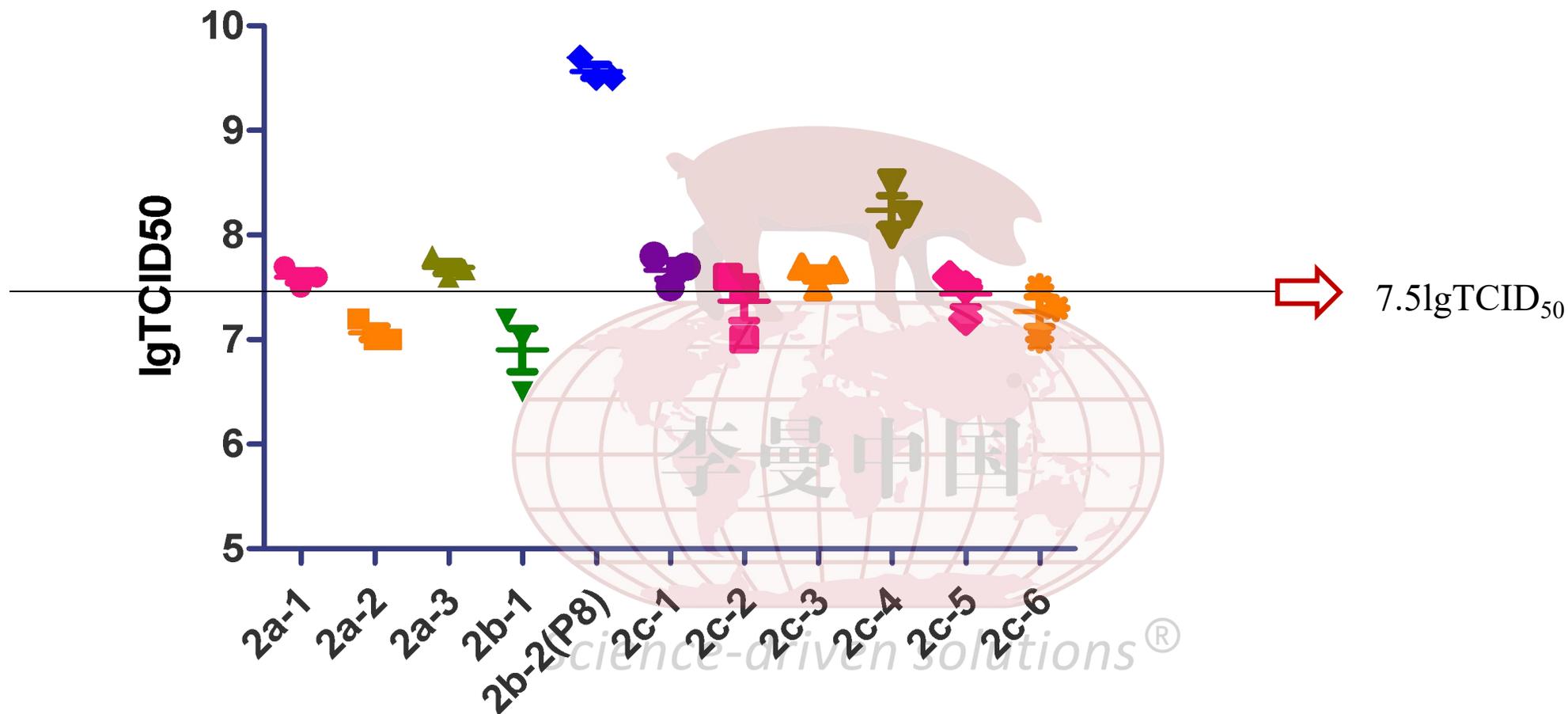
对ST-O细胞进行悬浮驯化，获得可稳定传代的**ST-O8悬浮细胞株**，细胞倍增时间20小时左右，对PEDV极为易感，以MOI =0.01比例接毒后，培养**16小时收毒**，PEDV-P8悬浮毒价**9.5LgTCID₅₀**。

ST-O cells were subjected to suspension domestication to obtain a stable passable ST-O8 suspension cell line. The cell doubling time was about 20 hours, and it was highly susceptible to PEDV. After inoculation at a MOI ratio of 0.01, the cells were cultured for 16 hours to collect the virus. The suspension toxicity value of PEDV-P8 was 9.5 LgTCID₅₀.



1、PEDV灭活疫苗工艺研究—不同毒株在ST细胞上悬浮培养

1. Process research on PEDV inactivated vaccine - suspension culture of different strains on ST cells



研究了PEDV 2a/2b/2c不同毒株在ST-O细胞上培养情况：毒价7.0-9.5lgTCID₅₀

The study investigated the cultivation of different strains of PEDV 2a/2b/2c on ST-O cells: the virus titer ranged from 7.0 to 9.5 lgTCID₅₀

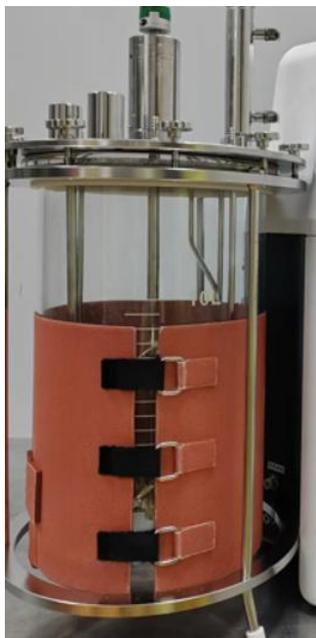


1、PEDV灭活疫苗工艺研究—完成500L悬浮培养、纯化工工艺研究

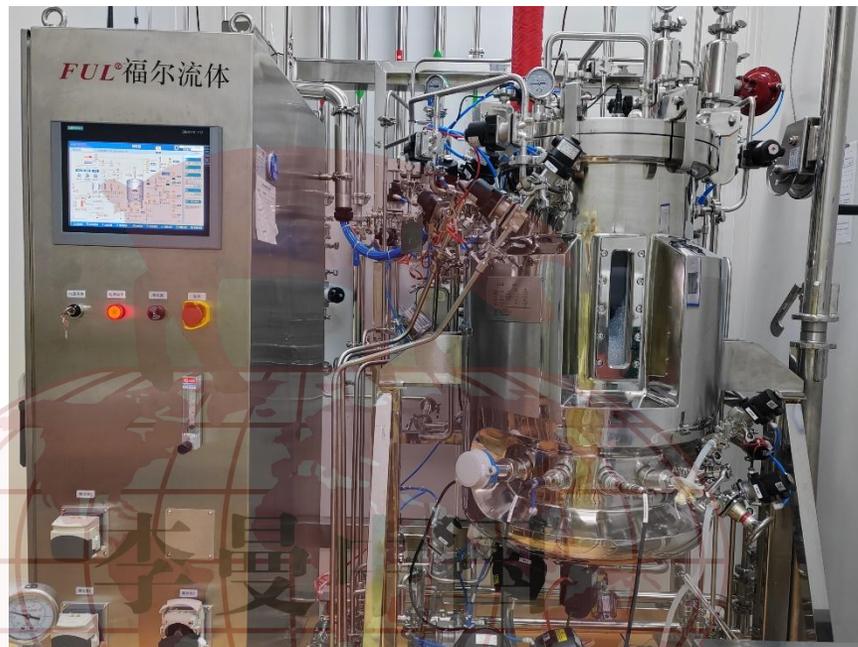
1. Research on the process of PEDV inactivated vaccine - complete the research on 500L suspension culture and purification process



摇瓶



10L反应器



100L反应器



500L反应器

Science-driven solutions®

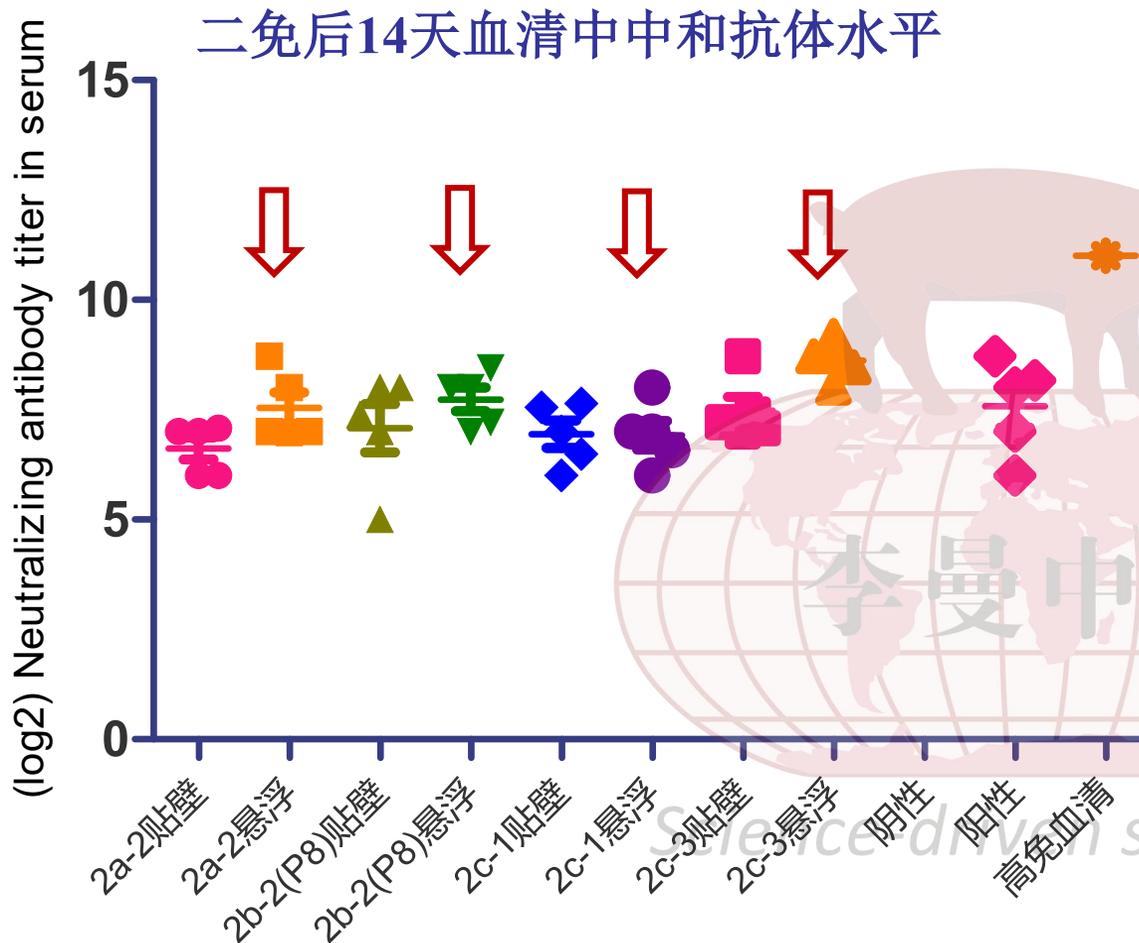
完成PEDV 2a、2b、2c相关毒株10L-500L悬浮培养、纯化工工艺研究，毒价7.5-9.5。

Complete the research on the suspension culture and purification process of PEDV 2a, 2b, 2c related strains from 10L to 500L, with a virus titer of 7.5-9.5.



2、PEDV灭活疫苗效力评价--悬浮毒株与贴壁毒株免疫原性评价

2. Efficacy evaluation of PEDV inactivated vaccine - immunogenicity evaluation of suspended and adherent virus strains



腹泻灭活疫苗免疫3-6日龄仔猪，一免后14天二免，二免后14天采血测中和抗体，可以看出悬浮抗原组中和水平高于贴壁抗原组。单抗原配制的疫苗中和抗体水平多集中在1:128-1:256之间。

The diarrhea inactivated vaccine was immunized in 3-6-day-old piglets, and the second immunization was given 14 days after the first immunization. Blood was collected 14 days after the second immunization to measure the neutralizing antibody level. It can be seen that the neutralizing level of the suspended antigen group is higher than that of the adherent antigen group. The neutralizing antibody level of the vaccine prepared with single antigen is mostly concentrated between 1:128-1:256.

不同毒株贴壁及悬浮抗原免疫原性评价

Evaluation of immunogenicity of adherent and suspended antigens from different strains



2、PEDV灭活疫苗效力评价- PEDV2C灭活疫苗被动免疫效果评价

2. Efficacy evaluation of PEDV inactivated vaccine - passive immunity effect evaluation of PEDV2C inactivated vaccine

PEDV-2c毒株，悬浮毒价 $10^{7.5}$ ，BEI灭活后201佐剂配制疫苗免疫阴性妊娠母猪，3-5日龄仔猪攻毒
PEDV-2c strain, suspension virus titer $10^{7.5}$, after BEI inactivation, 201 adjuvant formulated vaccine immunized negative pregnant sows, 3-5 day old piglets challenged with virus



产前9周免疫腹康活疫苗Immunize with Fangkang live vaccine 9 weeks before delivery

产前3周加强免疫PEDV-2C灭活疫苗Prenatal 3-week booster immunization with PEDV-2C inactivated vaccine

生产当天采集母猪初乳，测定中和抗体及IgA水平Collect colostrum from sows on the day of production and measure neutralizing antibody and IgA levels



免疫妊娠母猪
Immune pregnant SOW

产前6周免疫PEDV-2C灭活疫苗
6 weeks prenatal immunization with PEDV-2C inactivated vaccine

产前1周采血测定血清中IgA水平
Blood was collected one week before delivery to measure the level of serum IgA

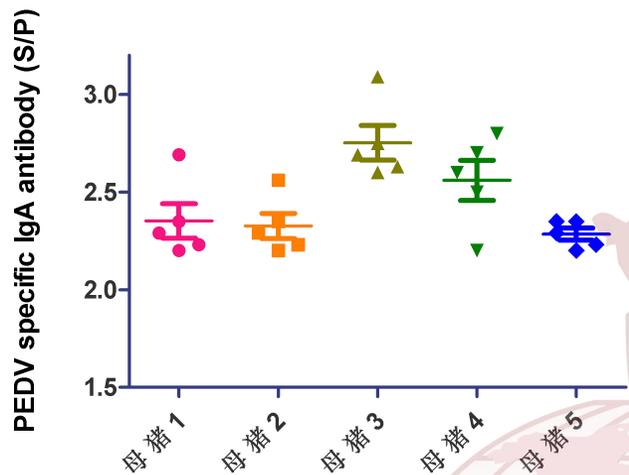


生产后3-6日龄仔猪攻毒
Challenge 3-6 days old post-production piglets

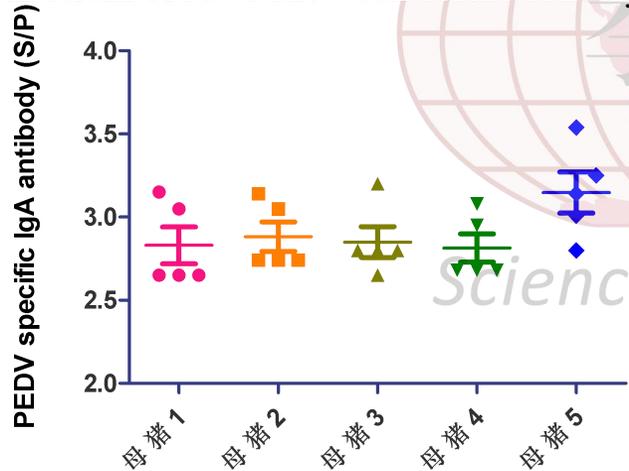


2、PEDV灭活疫苗效力评价- PEDV2C灭活疫苗被动免疫效果评价

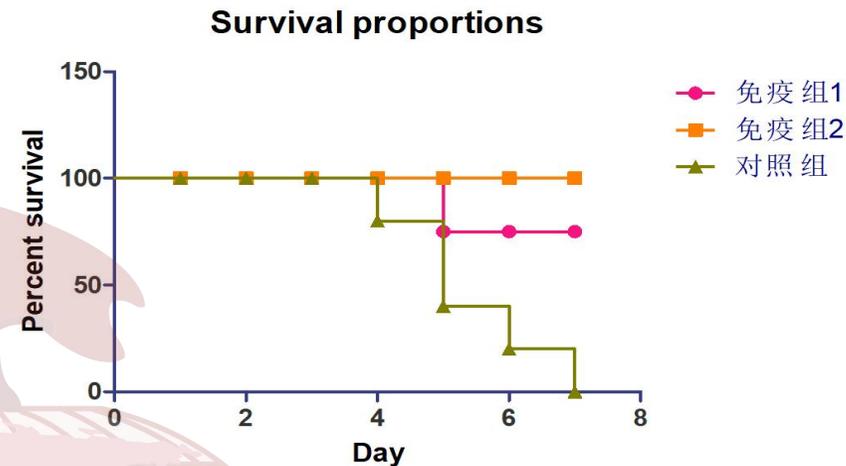
2. Efficacy evaluation of PEDV inactivated vaccine - passive immunity effect evaluation of PEDV2C inactivated vaccine



母猪产前一周血清中IgA S/P值
S/P value of IgA in serum of sows one week before delivery



母猪生产当天初乳中IgA S/P值
S/P value of IgA in sow colostrum on the day of farrowing



3-5日龄仔猪攻毒后存活率

Survival rate of 3-5 day-old piglets after challenge with the virus

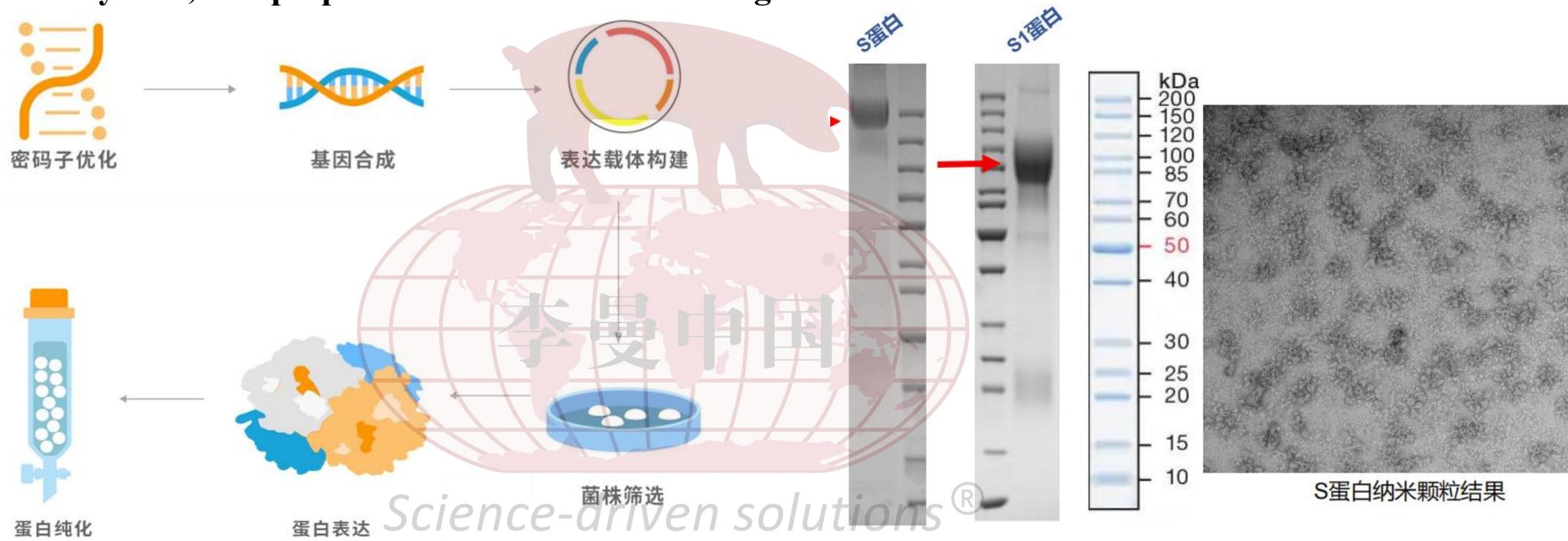
组别	攻毒用毒	保护率
免疫组1	PEDV 2c-5	80%
免疫组2	PEDV 2c-5	100%
对照组	PEDV 2c-5	0

3-5日龄仔猪攻毒后保护率80%-100%

The protection rate of 3-5 day-old piglets after being challenged with the virus is 80%-100%

3、PEDV亚单位疫苗研究3. Research on PEDV subunit vaccine

中牧研究院采用CHO表达系统构建了PEDV 2a、2c S蛋白稳转细胞株，制备三聚体及VLP抗原
The CAHIC Research Institute has constructed stable cell lines expressing PEDV 2a and 2c S proteins using the CHO expression system, and prepared trimeric and VLP antigens

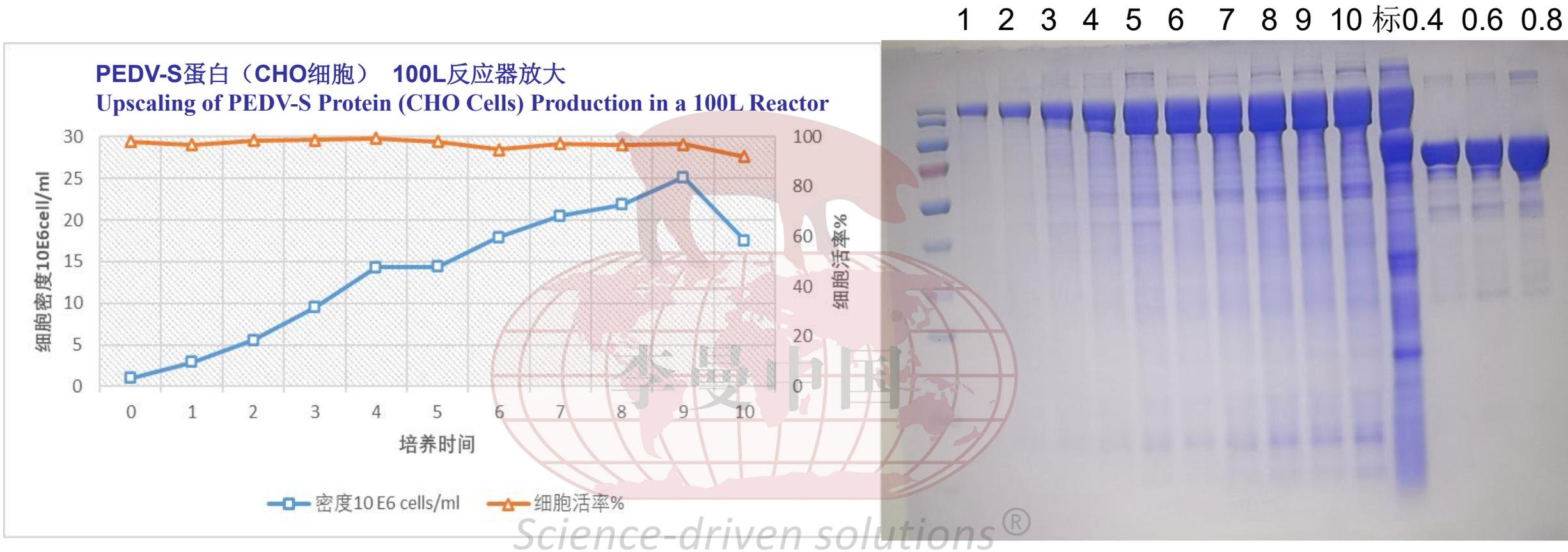


图A 基于CHO细胞表达系统策略的PEDV-S蛋白表达纯化
Figure A Expression and purification of PEDV-S protein based on CHO cell expression system strategy

图B PEDV-S/S1蛋白表达纯化后鉴定
Figure B Identification of PEDV-S/S1 protein after expression and purification



3、PEDV 亚单位疫苗研究3. Research on PEDV subunit vaccine



优化PEDV 2a、2c S蛋白CHO表达、纯化工艺，S蛋白**纯度85以上%**，**表达量2.0-4.0g/L**
Optimize the CHO expression and purification process of PEDV 2a and 2c S proteins, with a purity of over 85% and an expression level of 2.0-4.0g/L



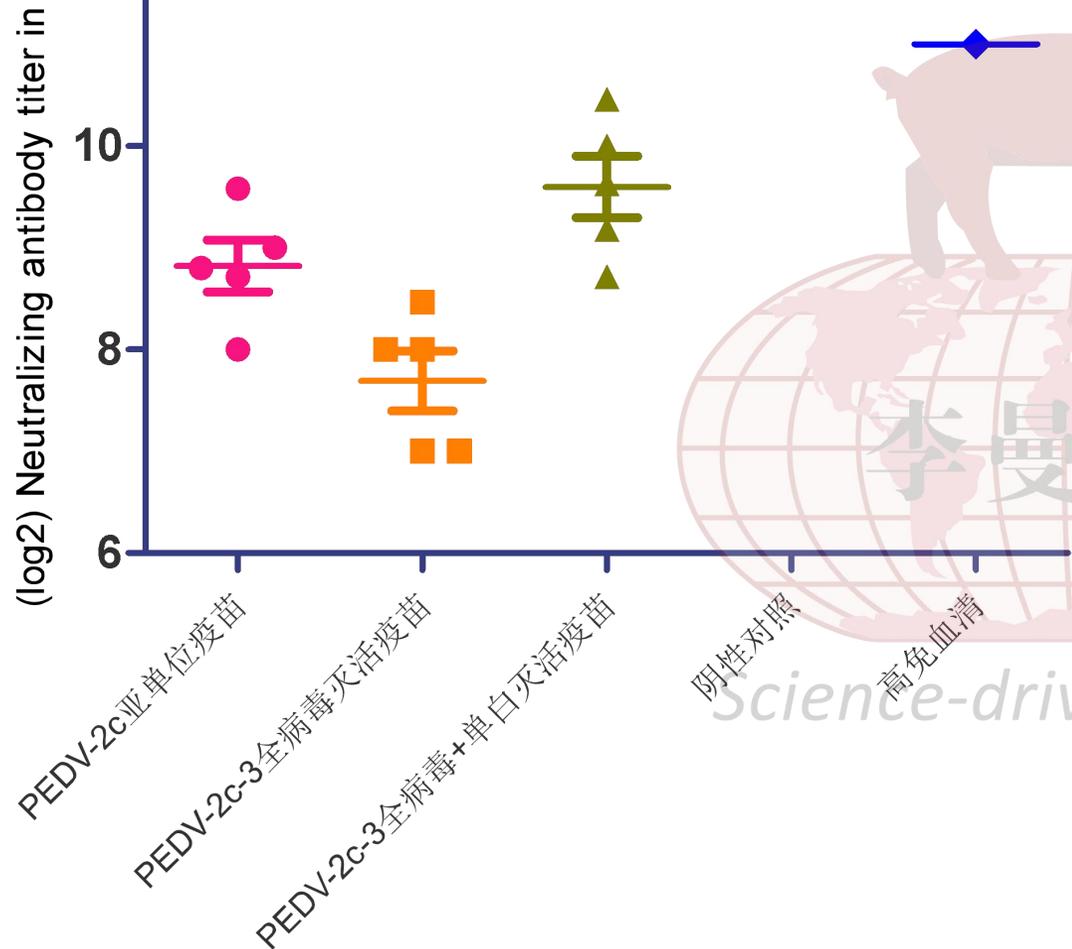
3、PEDV 亚单位疫苗研究—2C亚单位疫苗免疫试验

3. Research on PEDV subunit vaccine - 2C subunit vaccine immunization test

一免14天后二免，二免14天测中和抗体，攻毒

The first vaccination is followed by a second vaccination 14 days later. The neutralizing antibody is tested 14 days after the second vaccination, and the virus challenge is conducted

二免后14天中和抗体水平
Neutralizing antibody level within 14 days after the second dose



疫苗组别	抗原组成	中和抗体	攻毒结果
1	PEDV 2C亚单位100ug	512	100% 5/5
2	PEDV2C灭活抗原	181	80% 4/5
3	PEDV 2C亚单位100ug + PEDV2C灭活抗原	724	100% 5/5

攻毒后免疫组80%-100%保护，PEDV蛋白+灭活抗原组效果较好。

The immune group after virus challenge showed 80%-100% protection, and the PEDV protein + inactivated antigen group showed better results.

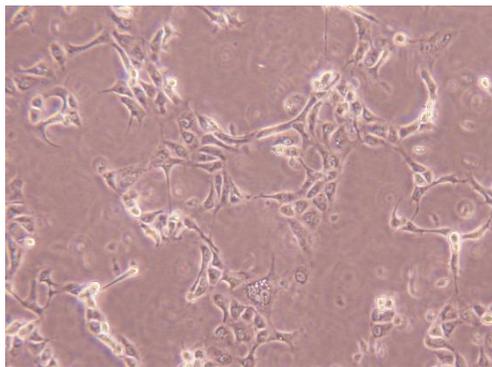


4、PoRV灭活疫苗工艺研究—贴壁培养工艺

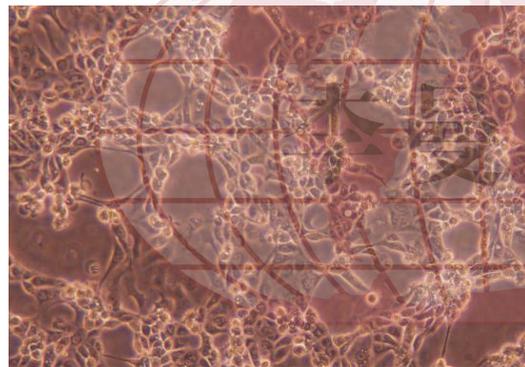
4. Research on the Process of PoRV Inactivated Vaccine - Adherent Culture Process

30

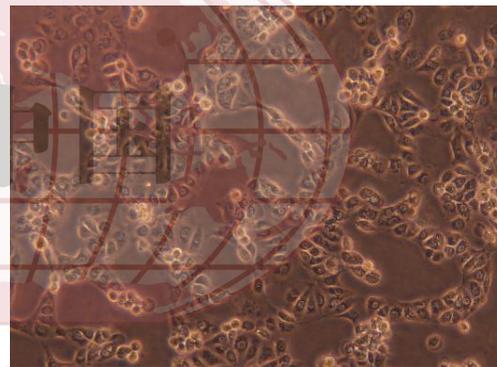
- ✓ 目前研究院已经分离鉴定几十株轮状病毒，挑选高毒价的G9型4株、G4型3株、G5型3株开展免疫原性及工艺研究。
- ✓ At present, the research institute has isolated and identified dozens of rotavirus strains, and selected 4 strains of G9 type, 3 strains of G4 type, and 3 strains of G5 type with high virulence for immunogenicity and process research.
- ✓ PK15细胞转瓶培养，轮状病毒毒价能达到 $10^{7.5-8.0}$ TCID₅₀/ml。
- ✓ The rotavirus titer can reach $10^{7.5-8.0}$ TCID₅₀/ml when PK15 cells are cultured in roller bottles.



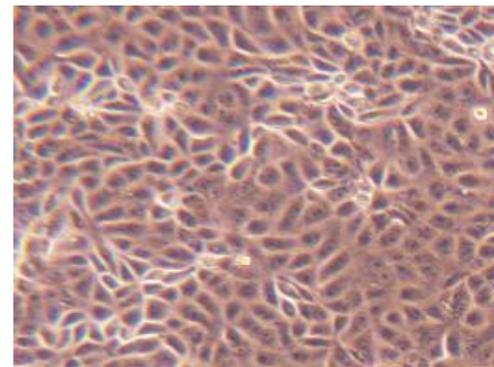
G9病变



G4病变



G5病变



细胞对照



4、PoRV灭活疫苗工艺研究—悬浮工艺研究

4. Research on the process of PoRV inactivated vaccine - suspension process research

- ✓ 通过细胞克隆和筛选，获得对轮状病毒高敏感的PK-15悬浮细胞系。
- ✓ A highly sensitive PK-15 suspension cell line to rotavirus was obtained through cell cloning and screening.
- ✓ 建立10L-500L轮状病毒无血清全悬浮培养工艺。
- ✓ Establish a serum-free whole suspension culture process for rotavirus ranging from 10L to 500L.

轮状病毒G9/G4/G5型500L悬浮培养的情况

Suspension culture of rotavirus G9/G4/G5 type 500L

轮状病毒	毒价 (Lg TCID ₅₀ /ml)
G9型-C1株	8.2
G9型-3-HB株	8.8
G5型-C1株	8.67
G4型-XJ	9.0





4、PoRV灭活疫苗工艺研究—纯化、灭活工艺研究

4. Research on the process of PoRV inactivated vaccine - purification and inactivation process research

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- ✓ 使用BEI 进行灭活，高效可靠，最大限度地保留抗原的免疫原性，安全性高，残留易处理。
- ✓ Using BEI for inactivation is highly efficient and reliable, maximizing the retention of the immunogenicity of the antigen, with high safety and easy-to-manage residuals.
- ✓ 建立了高效的轮状病毒抗原纯化工艺，抗原纯度高，抗原含量灭活前8.0 Lg TCID₅₀/mL。
- ✓ An efficient purification process for rotavirus antigen has been established, with high purity and an antigen content of 8.0 Lg TCID₅₀/mL before inactivation.
- ✓ 201油包水进口佐剂，具有持久高效的免疫增强效果，质量可靠有保障。
- ✓ 201 oil-in-water import adjuvant, with long-lasting and highly effective immune enhancement effect, reliable and guaranteed quality.



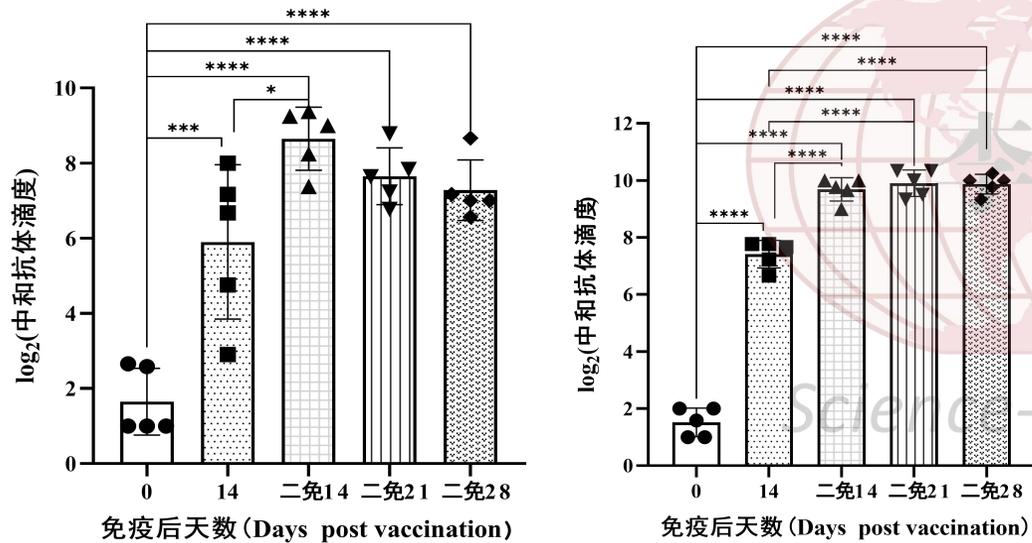


5、PoRV灭活疫苗免疫效果评价—G9

5. Evaluation of immune effect of PoRV inactivated vaccine - G9

轮状病毒G9-C1株、G9-3-HB悬浮培养抗原灭活后配制疫苗，各免疫3-6日龄抗体阴性猪10头，耳根后肌注2ml/头，对照组5头，14日后二免，二免后14天免疫组各选5头仔猪采血测中和抗体，同时攻毒，免疫组余下5头仔猪21、28天继续采血测中和抗体。结果表明，G9-C1株、G9-3-HB株灭活疫苗对攻毒可提供100%保护，同时有较高中和抗体，抗体滴度达到1:95以上。

Vaccines were prepared using inactivated rotavirus G9-C1 and G9-3-HB suspension culture antigens, and 10 antibody-negative pigs aged 3-6 days were immunized with 2ml/head intramuscularly at the back of the ear. A control group of 5 pigs was also immunized. After 14 days, a second vaccination was given. Fourteen days after the second vaccination, 5 pigs from each group were selected for blood collection to measure neutralizing antibodies, and at the same time, they were challenged with the virus. The remaining 5 pigs in the immunized group were continuously blood collected at 21 and 28 days to measure neutralizing antibodies. The results showed that the inactivated vaccines of G9-C1 and G9-3-HB strains provided 100% protection against challenge, and had high neutralizing antibodies, with antibody titers above 1:95.



组别	28天中和抗体水平	保护率	攻毒用毒
G9-C1株	1:95~1:406	100%	G9-4株
G9-3-HB株	1:645~1:1218	100%	
空白组	1:2~1:6	5/5发病	

G9-C1株、G9-3-HB疫苗免疫效果评价结果

Evaluation results of immune effects of G9-C1 strain and G9-3-HB vaccine

G9-C1株、G9-3-HB株灭活疫苗对猪只可提供100%保护

The inactivated vaccines of G9-C1 strain and G9-3-HB strain can provide 100% protection for pigs



四、猪病毒性腹泻相关检测方法的建立

IV. Establishment of Detection Methods for Porcine Viral Diarrhea

1、猪腹泻类疫病抗原检测技术建立 1. Establishment of antigen detection technology for porcine diarrhea diseases

2、猪腹泻类疫病抗体检测技术建立 2. Establishment of antibody detection technology for porcine diarrhea diseases

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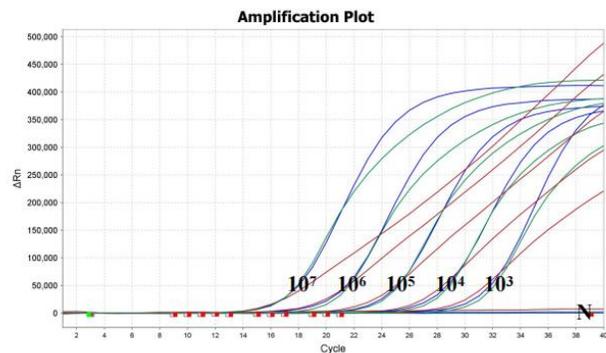


1、猪腹泻类疫病抗原检测技术建立

1. Establishment of antigen detection technology for porcine diarrhea diseases

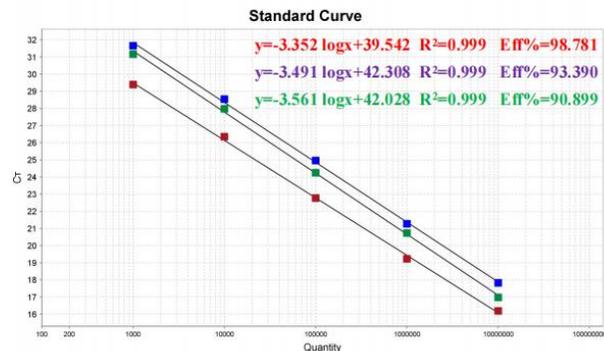
■ 建立通用型三重腹泻荧光 PCR 技术 (PEDV-PoRV-PDCoV) FAM-Cy5-VIC

■ Establish a universal triple diarrhea fluorescent PCR technology (PEDV-PoRV-PDCoV) FAM-Cy5-VIC



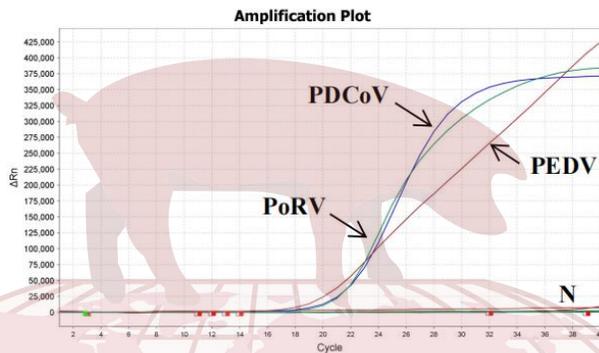
■ PDCoV ■ PEDV ■ PoRV

标准质粒扩增



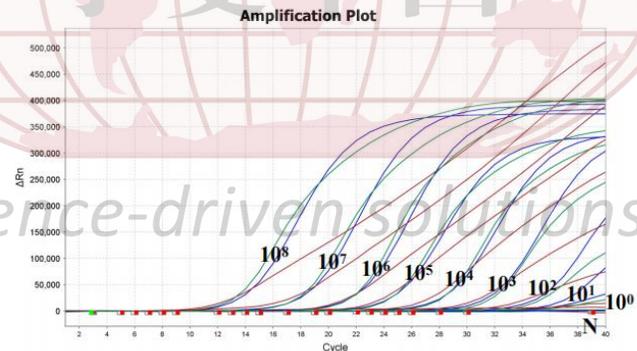
■ PoRV ■ PEDV ■ PDCoV

标准曲线建立



■ PDCoV ■ PEDV ■ PoRV

特异性试验



■ PDCoV ■ PEDV ■ PoRV

敏感性试验

反应组分	体积 (μL)
TaqMan 2 x Mix 预混液	10
上游引物 F (10 μmol/L)	0.4/0.5/0.4
下游引物 F (10 μmol/L)	0.4/0.5/0.4
探针 P (10 μmol/L)	0.3/0.3/0.3
ROX (50 x)	0.4
RNase-free 水	4.1
模板	2.0

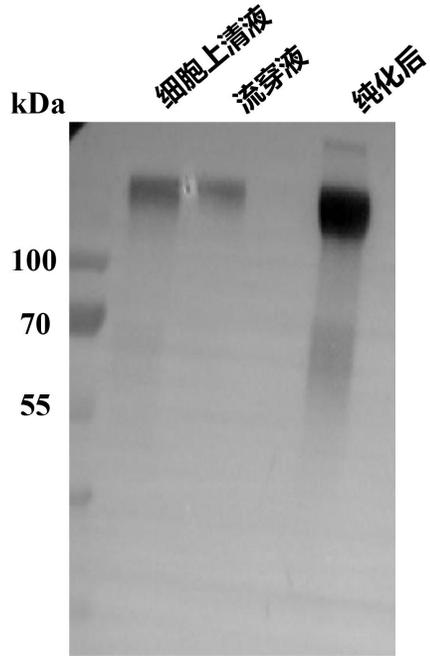
步骤	温度 (°C)	时间	循环数
预变性	95	5 min	1
变性	95	10 s	1
退火/延伸	60	30 s	40



2、猪腹泻类疫病抗体检测技术建立

2. Establishment of antibody detection technology for porcine diarrhea diseases

- 建立 PEDV IgG/IgA 抗体检测方法
- Establishment of PEDV IgG/IgA Antibody Detection Method



PEDV-S1蛋白表达纯化后鉴定
Identification of PEDV-S1 protein after expression and purification

PEDV IgG抗体检测与病毒中和试验的符合率98.33%
The consistency rate between PEDV IgG antibody detection and virus neutralization test was 98.33%

		病毒中和试验		
		阳性	阴性	总计
自研 IgG 抗体 检测试剂盒	阳性	53	0	53
	阴性	1	6	7
	总计	54	6	60

PEDV IgA抗体检测与商品化试剂盒的符合率
The consistency rate between PEDV IgA antibody detection and commercialized test kits

编号	IgA (S/P)	
	IDEXX	PEDV-S1
7828	0.016	0.028
7829	0.733	0.856
7830	0.030	0.038
7831	0.011	0.109
7832	0.030	0.049
7833	1.568	1.389
7834	0.559	0.612
7835	0.025	0.008
7836	0.022	0.015
7837	0.865	0.973
7838	0.038	0.060
7839	0.016	0.056
7840	0.554	0.601
1-1	0.039	0.056
1-2	0.063	0.086
2-1	0.651	0.568
2-2	0.294	0.370
3-1	0.771	0.693
3-2	-0.016	0.008
4-1	0.102	0.096
4-2	0.023	0.049
高免血清	1.980	1.756
脐带血	-0.106	0.144
BC6-A3	2.054	1.988
BC4-A9	1.078	1.115
BC5-A17	0.688	0.732
BC5-B5	1.902	2.021
BC4-B9	0.326	0.228
BC6-B14	0.412	0.305
BC4-C3	2.030	1.973
BC5-C3	1.525	1.651
BC5-C4	1.409	1.328
BC4-C8	1.254	1.269
BC4-C9	0.199	0.201
BC4-C10	0.527	0.663
BC5-C1	0.638	0.725
BC5-C2	0.258	0.246
BC5-C3	0.924	0.886
BC5-C4	0.364	0.315
BC5-C5	0.727	0.831
BC5-C6	0.497	0.502
NC	0.094	0.073
PC	0.552	0.606

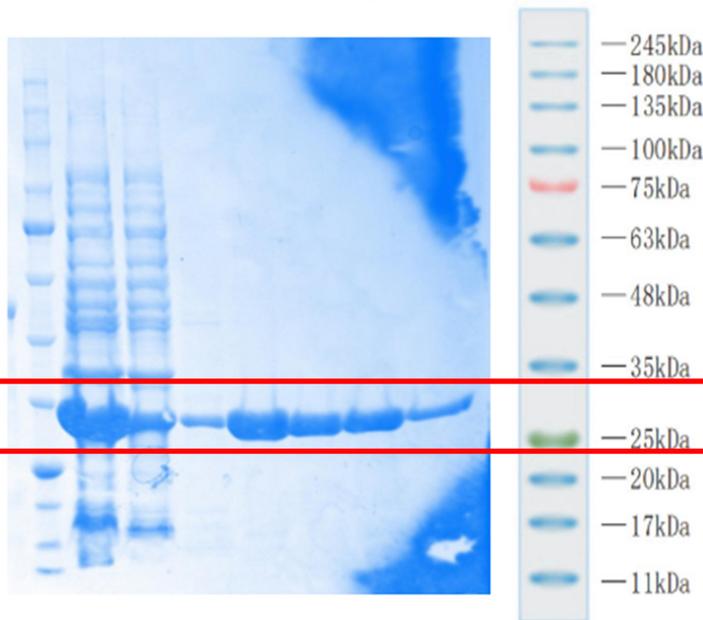
2、猪腹泻类疫病抗体检测技术建立

2. Establishment of antibody detection technology for porcine diarrhea diseases

■ 建立 PoRV IgG/IgA 抗体检测方法

■ Establishment of a method for detecting PoRV IgG/IgA antibodies

M 1 2 3 4 5 6 7



PoRV-VP8蛋白表达纯化后鉴定
Identification of PoRV-VP8 protein after expression and purification

PoRV IgG/IgA 抗体检测试剂盒、商品化试剂盒与病毒中和试验的符合率

The consistency rate between PoRV IgG/IgA antibody detection kit, commercial kit and virus neutralization test

		病毒中和试验		
		阳性	阴性	总计
商品化试剂盒 95%	阳性	55	1	56
	阴性	2	2	4
	总计	57	3	60
自研 IgG 抗体 检测试剂盒 96.67%	阳性	56	1	57
	阴性	1	2	3
	总计	57	3	60
自研 IgA 抗体 检测试剂盒 93.33%	阳性	54	1	55
	阴性	3	2	5
	总计	57	3	60



中牧实业股份有限公司情况简介

Introduction to China Animal Husbandry Industry Co., Ltd

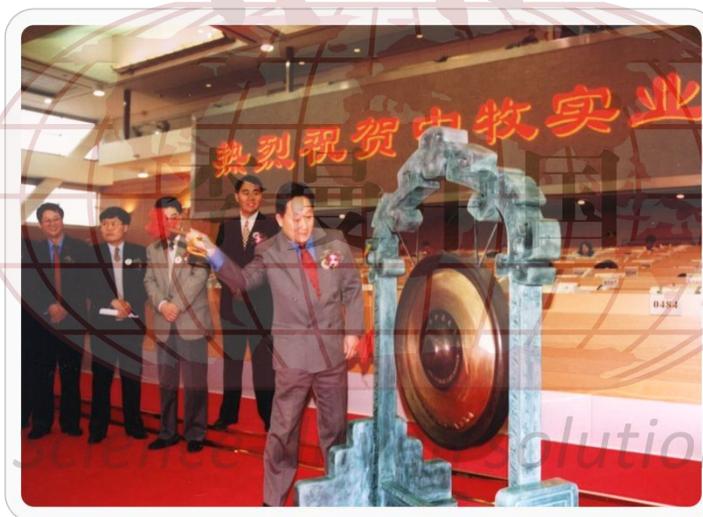
Science-driven solutions[®]



1、公司概况1. Company Overview



中牧实业股份有限公司是由中国牧工商（集团）总公司于1998年底独家发起成立的央企控股农牧业上市公司，股票于1999年1月7日在上海证券交易所上市。China Animal Husbandry Industry Co., Ltd. is a listed company in the agricultural and animal husbandry industry, controlled by a central enterprise. It was exclusively initiated and established by China Animal Husbandry Industry (Group) Corporation at the end of 1998. Its shares were listed on the Shanghai Stock Exchange on January 7, 1999.



成立日期: 1998年12月25日
Date of establishment: December 25, 1998

上市时间: 1999年1月7日
Time of listing: January 7, 1999

股票简称: 中牧股份
Stock abbreviation: CAHIC Stock

股票代码: 600195, SH
Stock code: 600195, SH



1、公司概况 1. Company Overview



公司全称：中牧实业股份有限公司
Full name of the company: CAHIC Industrial Co., Ltd

公司简称：中牧股份 (600195)
Company Abbreviation: CAHIC Stock (600195)

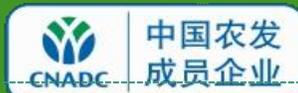
独家发起：中国牧工商集团有限公司
Exclusive sponsor: China Animal Husbandry Industry and Commerce Group Co., Ltd

实际控制人：中国农业发展集团有限公司
Actual controller: China Agricultural Development Group Co., Ltd

中牧股份总股本：10.21亿股 Total share capital of China Animal Husbandry Group: 1.021 billion shares

从2014年1月1日起，中牧股份作为中国农发集团二级企业管理

Since January 1, 2014, China Animal Husbandry Group has been managed as a secondary enterprise of China Agricultural Development Group





2、中国农业发展集团有限公司

2. China Agriculture Development Group Co., Ltd



渔业板块 Fishing industry

以远洋捕捞、水产品加工、渔业服务为重点

Focusing on deep-sea fishing, aquatic product processing, and fishery services



种业板块 Seed industry sector

以农作物种业为重点

with a focus on crop seed industry



畜牧业板块 Animal Husbandry Sector

以动物保健品和动物营养品为核心的畜牧业动保产业为重点

Focus on animal health products and animal nutrition products in animal husbandry and animal protection industry



农业服务板块 Agricultural Service Sector

以农机装备、农场、农业工程、粮食农资和农产品供应链经营

In the fields of agricultural machinery and equipment, farms, agricultural engineering, agricultural resources, and the supply chain management of agricultural products

四大板块横跨农牧渔领域，纵贯一二三产业，是中央企业中服务功能最完整的多元化农业集团

The four major sectors span the fields of agriculture, animal husbandry, and fishery, and run through the primary, secondary, and tertiary industries. They are the most comprehensive diversified agricultural groups in terms of service functions among central enterprises

集团现有二级企业17家，控股3家上市公司，在岗职工总数2万多人

The group currently has 17 secondary enterprises, controls 3 listed companies, and has a total of more than 20,000 employees on the job

定位
使命
愿景

Positioning
mission
vision

中国农发集团是国务院国资委直接管理的唯一一家以农业为主责主业的中央企业

China Agricultural Development Group is the only central enterprise directly managed by the State-owned Assets Supervision and Administration Commission of the State Council, with agriculture as its main responsibility and main business

中国农发集团要成为现代农业全产业链的综合服务商，在服务“三农”中践行国家队、主力军

China Agricultural Development Group should become a comprehensive service provider of the whole industrial chain of modern agriculture, and practice as the national team and main force in serving the "three rural issues"

中国农发集团要成为农业现代化、产业化和国际化领军企业

China Agricultural Development Group should become a leading enterprise in agricultural modernization, industrialization and internationalization

China Agricultural Development Group should become a leading enterprise in agricultural modernization, industrialization and internationalization





3. 行业地位 3. Industry position



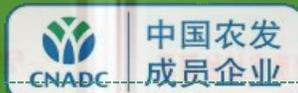
中国农发
成员企业



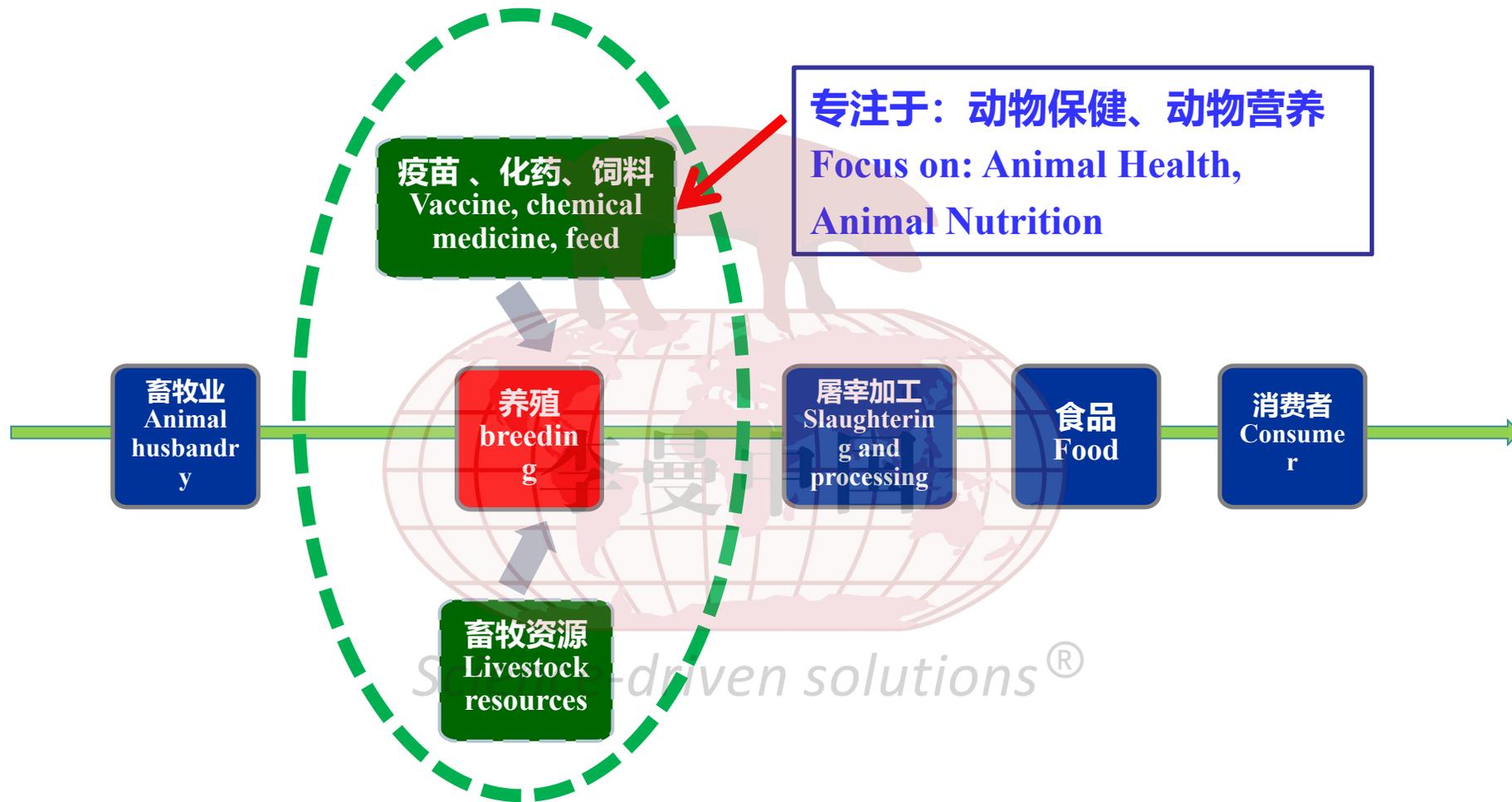
中牧实业股份有限公司
CHINA ANIMAL HUSBANDRY INDUSTRY CO., LTD.



- 国家农业产业化重点龙头企业
- National key leading enterprise in agricultural industrialization
- 国内最早从事兽用生物制品的研发生产机构
- The earliest research and production institution of veterinary biological products in China
- 重大动物疫病防控疫苗最齐全的定点生产企业
- The designated production enterprise with the most complete vaccines for major animal disease prevention and control
- 我国第一家复合维生素生产企业
- The first compound vitamin manufacturer in China
- 我国饲料工业30强企业
- Top 30 enterprises in China's feed industry
- 国内规模最大的兽药原料和预混剂生产企业之一
- One of the largest producers of veterinary drug raw materials and premixes in China



💡 3、行业地位 3. Industry status



💡 4、主营业务 4. Main business

两大支柱
Two major pillar



兽用生物制品
Veterinary biological products



兽用化学药品
Veterinary chemical drug



饲料及饲料添加剂
Feed and feed additives



原料贸易
Raw material trade



中国农发
成员企业



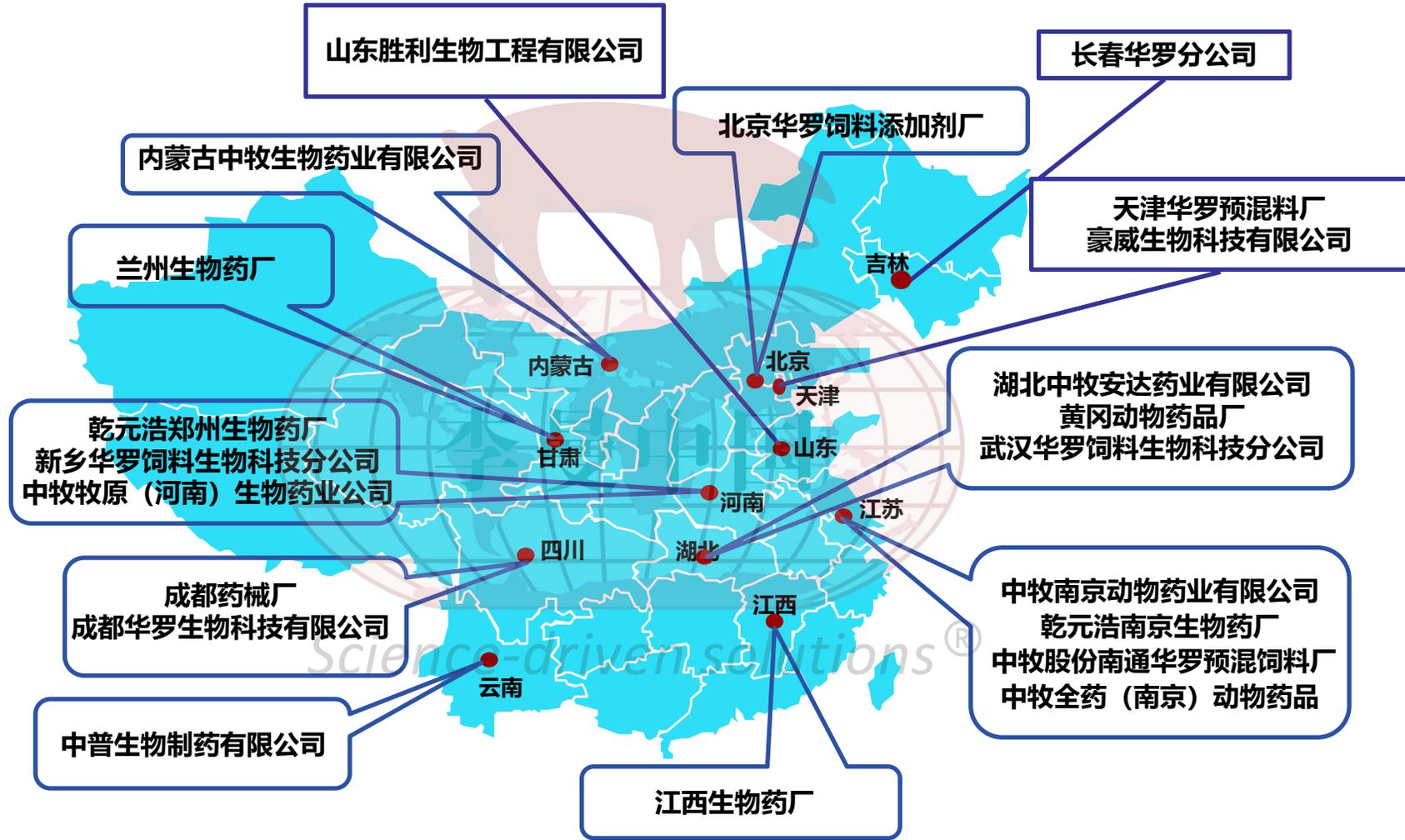
中牧股份
CAHIC



5、生产基地：22个，其中生药7个、化药8个、饲料7个

5. Production bases: 22, including 7 for raw medicine, 8 for chemical medicine, and 7 for feed

两大
支柱
Two
major
pillar



保 护 动 物 安 全 关 爱 人 类 健 康

牢记央企使命 坚守品质初心



Science-driven solutions[®]

品质疫苗助力动物疫病精准防控！
Quality vaccines help prevent and control animal diseases accurately!

