



การประเมินประสิทธิภาพของน้ำยาฆ่าเชื้อต่อเชื้อไวรัสโรคปากและเท้าเปื่อยภายใต้
สภาวะห้องปฏิบัติการ

Evaluation of the Efficacy of Disinfectants Against Foot-and-Mouth Disease
Virus in Laboratory Conditions

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Background

Foot-and-Mouth Disease (FMD) and the Importance of Disinfection

WHAT IS FMD?

- Foot-and-mouth disease virus (FMDV) is a highly contagious pathogen affecting cloven-hoofed animals.
- Causes severe economic losses due to reduced productivity, movement restrictions and trade limitations.
- Classified as a transboundary animal disease requiring rapid control and containment.



TRANSMISSION ROUTES



Direct contact



Aerosols



Contaminated
feed and water



Fomites
(equipment, vehicles,
clothing)

WHY DISINFECTION MATTERS?

- ✓ FMDV can survive in the environment and contaminated organic materials.
- ✓ Effective disinfection helps to:
 - Interrupt virus transmission
 - Reduce environmental contamination
 - Enhance biosecurity in farms and laboratories
- ✓ Disinfectant efficacy depends on:
 -  Temperature
 -  Contact time
 -  Concentration
 -  pH



What is the question study?

FMD

Transmission

Environmental survival

Disinfectants

Study Rationale



- Different disinfectants vary in their ability to inactivate FMDV
- Lab efficacy may differ from field performance
- Evidence – base selection disinfectants is critical for outbreak control and preparedness

Objective:

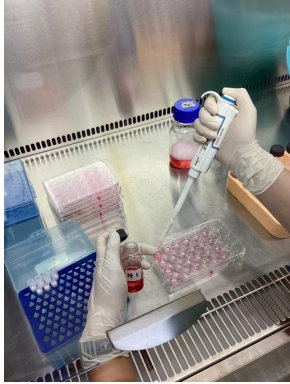
This study aimed to evaluate the virucidal efficacy of various disinfectants against FMDV under controlled laboratory conditions.

- To evaluate the virucidal efficacy of commonly used disinfectants under laboratory conditions.
- Add more options for selecting disinfectants for DLD and Stakeholders.



To evaluate and compare the efficacy of commonly used disinfectants against Foot-and-Mouth Disease Virus (FMDV) under controlled laboratory conditions and identify suitable disinfectants for strengthening biosecurity and disease control programs.

Materials and Methods



FMDV strain(s) used



Cell line for virus titration (e.g., BHK-21)



List of Disinfectant Samples



Cell Toxicity Evaluation



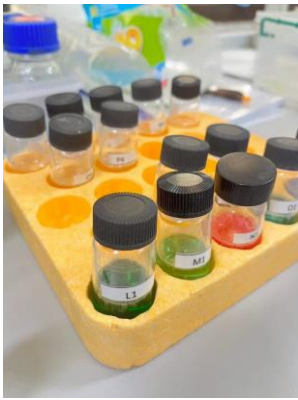
Testing of Acidity and Alkalinity (pH) Properties



Inhibitory Test for Foot-and-Mouth Disease Virus (FMDV) by Virus Inactivation Assay



Testing for residual viruses in virus-disinfectant mixture solutions



Disinfectants

- Effective disinfection is essential to control FMDV, especially in high-risk livestock areas.
- This study shows that disinfectant efficacy is influenced by organic matter and pH conditions. Glutaraldehyde-based disinfectants proved most effective, but proper cleaning and safe handling are crucial. These findings support improved biosecurity strategies to prevent FMDV spread in agricultural settings.

No.	Code.	Detail
1	A	BETA Superior GQ4 20% (Glutaraldehyde 10%) Lot. PH-23-HY-06-005/04-01 MFD.15-3-24
2	B	BETA Superior GQ2 25% (Glutaraldehyde 15%) Lot. PH-23-HY-06-005/02-01 MFD.15-3-24
3	C	NEXGEN SAN 820 (Glutaraldehyde 10%) Lot. 56141/01-03 MFD.15-3-24
4	D	SPARTAN GQ15 Lot no. :12566010 MFD.31/10/23 EXP.31/10/24
5	E	SPARTAN GQ15 Lot no. :12466004 MFD.17/11/23 EXP.17/11/24
6	F	No information
7	G	A.D. QUAT ALPHA Lot. 2401013-003 MFG. 13/1/24
8	H	GLUTARAL SUPER Lot. 2401013-002-004 MFG. 13/1/24
9	I	Microcide 478 (RRL)
10	J	BETA Basic Q1 10% (Alkyl benzyl dimethyl ammonium chloride 10%) PH-23-HY-06-002/03-02 12/06/2024
11	K	BETA MEDIUM IK 3% (Iodine as available iodine 3%) PH-23-HY-06-003/01-07/06/2024
12	L	BETA Superior GQ4 20% F (Glutaraldehyde 10% , Alkyl benzyl dimethyl ammonium chloride 4% , Octyldecyl dimethyl ammonium chloride 3% , Dioctyl dimethyl ammonium chloride 1.5%, Didecyl dimethyl ammonium chloride 1.5%) PH-24-HY-06-001/01-01 18/06/2024
13	M	BETA Medium GQ2 20% (Glutaraldehyde 10%, Alkyl benzyl dimethyl ammonium chloride 10%) PH-23-HY-06-005/03-02 07/06/2024
14	N	BETA Medium GQ1 25% (Glutaraldehyde 15%, Alkyl benzyl dimethyl ammonium chloride 10%) PH-23-HY-06-002/05-02 18/06/2024
15	O	BEZACLEAN (Glutaraldehyde 15.6% , Alkyl benzyl dimethyl ammonium chloride 7.5% , Octyldecyl dimethyl ammonium chloride 2.75% , Dioctyl dimethyl ammonium chloride 1.375%, Didecyl dimethyl ammonium chloride 1.375%, Polyoxyethylene lauryl ether 3%) PH-24-HY-06-004/01-01 18/06/2024
16	P	GLUTAFOAM (Glutaraldehyde 11.2% , Alkyl benzyl dimethyl ammonium chloride 12.5%, Octyldecyl dimethyl ammonium chloride 2.35% , Dioctyl dimethyl ammonium chloride 1.175%, Didecyl dimethyl ammonium chloride 1.175%, Alkyl glycoside 2%) PH-24-HY-06-004/03-02 18/06/2024

Shows the Cell Toxicity values of the disinfectants to BHK21 cells

Cell toxicity was evaluated to determine the impact of FMDV strain infection and disinfectant treatment on BHK-21 cells.



1: 10⁻⁴ (log -4)- 10⁻⁵ (log -5)

Disinfectant Name	Maximum dilution level that did not affect cells
Disinfectant A	1: 10 ⁻⁵ (log -5)
Disinfectant B	1: 10 ⁻⁵ (log -5)
Disinfectant C	1: 10 ⁻⁵ (log -5)
Disinfectant D	1: 10 ⁻⁵ (log -5)
Disinfectant E	1: 10 ⁻⁵ (log -5)
Disinfectant F	1: 10 ⁻⁴ (log -4)
Disinfectant G	1: 10 ⁻⁵ (log -5)
Disinfectant H	1: 10 ⁻⁵ (log -5)
Disinfectant I	1: 10 ⁻⁵ (log -5)
Disinfectant J	1: 10 ⁻⁴ (log -4)
Disinfectant K	1: 10 ⁻⁵ (log -5)
Disinfectant L	1: 10 ⁻⁵ (log -5)
Disinfectant M	1: 10 ⁻⁵ (log -5)
Disinfectant N	1: 10 ⁻⁵ (log -5)
Disinfectant O	1: 10 ⁻⁵ (log -5)
Disinfectant P	1: 10 ⁻⁵ (log -5)

pH Values of 16 Disinfectants

The cytotoxicity of 16 disinfectants against BHK-21 cells was evaluated using a ten-fold dilution series starting from 1:100

Disinfectant Name	pH Value of Original Dilution	Dilution	pH Value of Working Dilution	Dilution	Classification at the working dilution
Disinfectant A	3.54	10 ⁰	5.66	10 ⁻⁵	Acidic
Disinfectant B	3.03	10 ⁰	5.73	10 ⁻⁵	Acidic
Disinfectant C	3.21	10 ⁰	5.53	10 ⁻⁵	Acidic
Disinfectant D	3.22	10 ⁰	5.45	10 ⁻⁵	Acidic
Disinfectant E	3.05	10 ⁰	5.54	10 ⁻⁵	Acidic
Disinfectant F	1.29	10 ⁰	5.10	10 ⁻⁴	Acidic
Disinfectant G	5.57	10 ⁰	6.55	10 ⁻⁵	Acidic
Disinfectant H	3.49	10 ⁰	5.70	10 ⁻⁵	Acidic
Disinfectant I	4.31	10 ⁰	5.96	10 ⁻⁵	Acidic
Disinfectant J	6.005	10 ⁰	6.838	10 ⁻⁴	Acidic
Disinfectant K	1.434	10 ⁰	7.310	10 ⁻⁵	Neutral
Disinfectant L	3.885	10 ⁰	7.063	10 ⁻⁵	Neutral
Disinfectant M	3.795	10 ⁰	7.040	10 ⁻⁵	Neutral
Disinfectant N	3.846	10 ⁰	7.247	10 ⁻⁵	Neutral
Disinfectant O	3.322	10 ⁰	7.291	10 ⁻⁵	Neutral
Disinfectant P	3.439	10 ⁰	7.032	10 ⁻⁵	Neutral

Efficiency of
Disinfectants
Against Foot-and-Mouth Disease
Virus (FMDV):

Serotype O (O/Cathay)				Serotype A (A/Sakol)				Serotype Asia1			
Tested at Log TCID50				Tested at Log TCID50				Tested at Log TCID50			
10 Min.	20 Min.	30 Min	40 Min.	10 Min.	20 Min.	30 Min	40 Min.	10 Min.	20 Min.	30 Min	40 Min.
-5.75	-5.75	-5.75	-5.50	-6.75	-6.50	-6.25	-6.25	-5.00	-4.50	-4.50	-4.50
-5.75	-5.75	-5.75	-5.50	-6.75	-6.75	-6.75	-6.75	-4.75	-4.75	-4.75	-4.50
-5.75	-5.75	-5.75	-5.75	-7.25	-7.00	-7.00	-7.00	-5.00	-4.75	-4.50	-4.50
-6.00	-5.75	-5.75	-5.50	-7.50	-7.25	-7.25	-7.25	-4.75	-4.75	-4.50	-4.50
-6.75	-6.75	-6.75	-6.50	-7.00	-6.75	-6.75	-6.75	-5.00	-5.00	4.75	-4.75
-7.00	-7.00	-7.00	-7.00	-6.50	-6.25	-6.25	-6.25	-4.75	-4.75	-4.50	-4.50
-7.25	-6.75	-6.75	-6.75	-7.75	7.75	-7.50	-7.25	-5.00	-4.75	-4.75	-4.75
-7.75	-7.75	-7.75	-7.00	-7.00	-6.75	-6.75	-6.75	-5.00	-5.00	-4.75	-4.75
-6.75	-6.75	-6.75	-6.75	-6.75	-6.75	-6.75	-6.75	-5.00	-4.75	-4.50	-4.50
-7.25	-7.25	-6.75	-6.75	-8.50	-8.75	-8.00	-7.50	-5.00	-4.75	-4.75	-4.75
-6.50	-6.50	-6.25	-6.00	-6.50	-6.50	-6.50	-6.50	-4.75	-4.75	-4.75	-4.75
-6.25	-6.00	-6.00	-5.75	-7.00	-6.75	-6.75	-6.00	-5.00	-4.75	-4.50	-4.50
-6.25	-6.25	-6.25	-6.25	-7.00	-6.75	-6.75	-6.00	-5.00	-4.75	-4.50	-4.50
-6.50	-6.50	-6.50	-6.25	-6.50	-6.50	-6.50	-6.25	-5.00	-5.00	-5.00	-4.75
-6.25	-6.25	-6.25	-6.25	-7.00	-6.75	-6.75	-6.75	-4.75	-4.75	-4.50	-4.50
-6.75	-6.25	-6.25	-6.25	-6.75	-6.50	-6.50	-6.50	-5.00	-4.75	-4.50	-4.50

Shows the Residual Foot-and-Mouth Disease Virus Activity in Disinfectant Mixtures (Log titer of Residual Foot-and-Mouth Disease Virus Activity in Disinfectant Mixtures)

Disinfectant Name	Maximum dilution level that did not affect cells	Serotype O (O/Cathay)	Serotype A (A/Sakol)	Serotype Asia1
Disinfectant A	1: 10 ⁻⁵ (log -5)	1: 10 ⁻⁴ (log -4)	1: 10 ⁻⁵ (log -5)	1: 10 ⁻⁴ (log -4)
Disinfectant B	1: 10 ⁻⁵ (log -5)	1: 10 ⁻³ (log -3)	1: 10 ⁻⁵ (log -5)	1: 10 ⁻⁵ (log -5)
Disinfectant C	1: 10 ⁻⁵ (log -5)	1: 10 ⁻³ (log -3)	1: 10 ⁻⁴ (log -4)	1: 10 ^{-3.5} (log -3.5)
Disinfectant D	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ^{-4.5} (log -4.5)	1: 10 ^{-4.5} (log -4.5)
Disinfectant E	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ^{-4.5} (log -4.5)	1: 10 ⁻⁴ (log -4)
Disinfectant F	1: 10 ⁻⁴ (log -4)	1: 10 ⁻³ (log -3)	1: 10 ⁻⁵ (log -5)	1: 10 ^{-4.5} (log -4.5)
Disinfectant G	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ⁻⁴ (log -4)	1: 10 ⁻⁴ (log -4)
Disinfectant H	1: 10 ⁻⁵ (log -5)	1: 10 ⁻³ (log -3)	1: 10 ⁻⁴ (log -4)	1: 10 ^{-4.5} (log -4.5)
Disinfectant I	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ⁻⁵ (log -5)	1: 10 ⁻³ (log -3)
Disinfectant J	1: 10 ⁻⁴ (log -4)	1: 10 ⁻⁵ (log -5)	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)
Disinfectant K	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ⁻³ (log -3)
Disinfectant L	1: 10 ⁻⁵ (log -5)	1: 10 ⁻³ (log -3)	1: 10 ^{-4.5} (log -4.5)	1: 10 ^{-4.5} (log -4.5)
Disinfectant M	1: 10 ⁻⁵ (log -5)	1: 10 ⁻³ (log -3)	1: 10 ⁻⁴ (log -4)	1: 10 ⁻⁴ (log -4)
Disinfectant N	1: 10 ⁻⁵ (log -5)	1: 10 ^{-4.5} (log -4.5)	1: 10 ^{-4.5} (log -4.5)	1: 10 ^{-3.5} (log -3.5)
Disinfectant O	1: 10 ⁻⁵ (log -5)	1: 10 ⁻⁴ (log -4)	1: 10 ^{-4.5} (log -4.5)	1: 10 ^{-4.5} (log -4.5)
Disinfectant P	1: 10 ⁻⁵ (log -5)	1: 10 ^{-3.5} (log -3.5)	1: 10 ^{-4.5} (log -4.5)	1: 10 ^{-3.5} (log -3.5)

Results

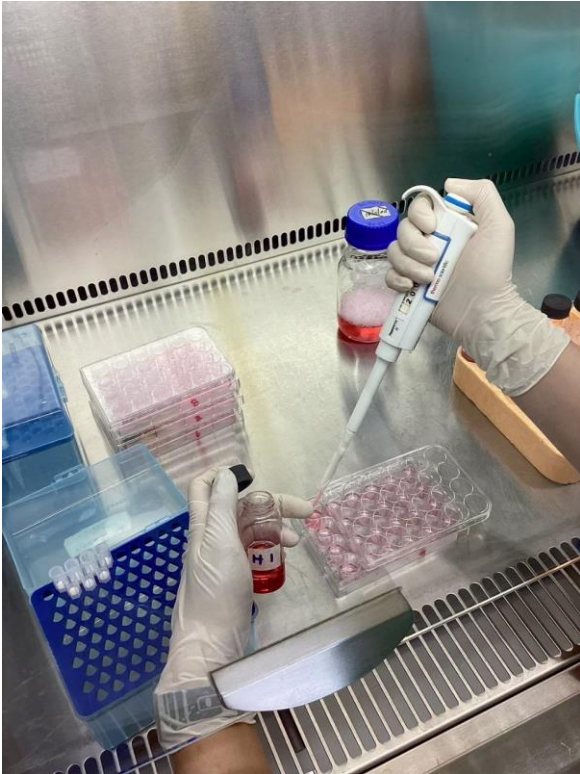
- Disinfectants containing aldehydes and oxidizing agents demonstrated the highest efficacy in inactivating FMDV, achieving complete viral inactivation within recommended exposure times.
- Quaternary ammonium compounds exhibited moderate effectiveness, requiring prolonged contact times for significant viral reduction.
- Phenolic-based disinfectants showed variable efficacy depending on concentration and environmental conditions.
- Some commercial disinfectants marketed for general use were found to have suboptimal efficacy against FMDV, highlighting the need for careful selection in outbreak scenarios.



DISCUSSION

- Non-enveloped viruses like FMDV and poliovirus have **proteinaceous capsids stabilized by strong interactions**, and glutaraldehyde cross-linking modifies critical structural proteins *in a concentration- and time-dependent manner*, thereby preventing attachment and uncoating. (Maha Kamal Gohar, 2017)
- For *FMDV* and other picornaviruses, studies show that **effective virucidal concentrations of glutaraldehyde often lie in the range 0.5–2% (w/v)** with **sufficient contact time (usually tens of minutes)**. At these concentrations, >4 log₁₀ reductions can be achievable, but this is highly dependent on environmental conditions (organic load, pH, etc.). (Rhee et al., 2022)

Conclusion

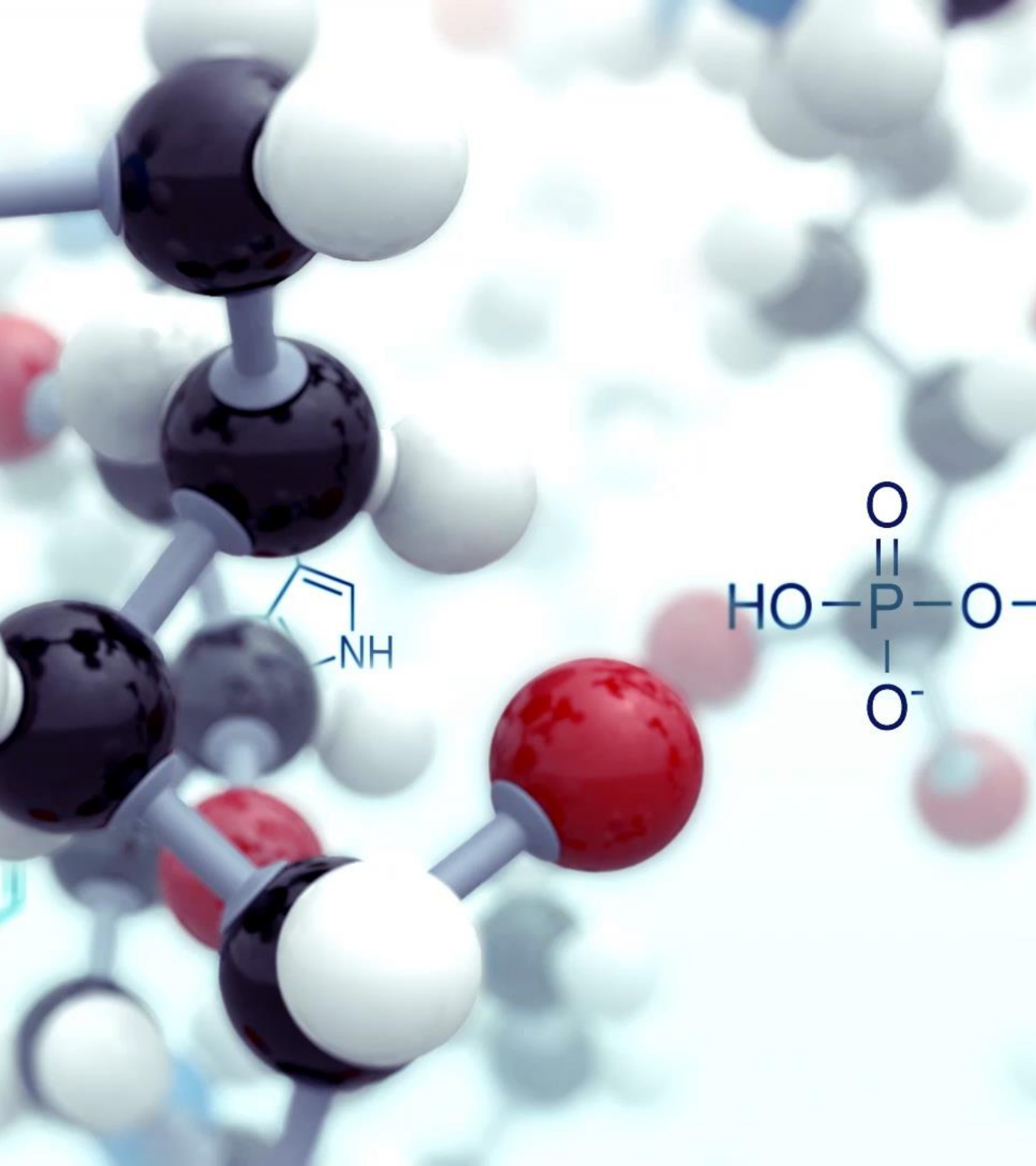


This study highlights the critical role of organic material in reducing the efficacy of certain disinfectants, particularly alcohol-based solutions and quaternary ammonium compounds.

Therefore, thorough cleaning prior to disinfection is essential, especially in high-risk environments such as livestock farms, vehicles, and slaughterhouses.

Among the tested agents, aldehyde-based disinfectants—especially glutaraldehyde—demonstrated the highest virucidal efficacy under various conditions.

While their effectiveness makes them suitable for situations requiring rapid and complete disinfection, their use must be balanced with proper safety measures due to potential toxicity.



Recommendation

This study provides critical data on the efficacy of commercial disinfectants against FMDV in Thailand. The findings emphasize the need for strategic selection of disinfectants to enhance biosecurity measures in livestock management. Recommendations from this research can inform policy decisions and improve FMD control efforts nationwide.



"Do it with all our heart, do it promptly and genuinely."

Thank you for your attention

