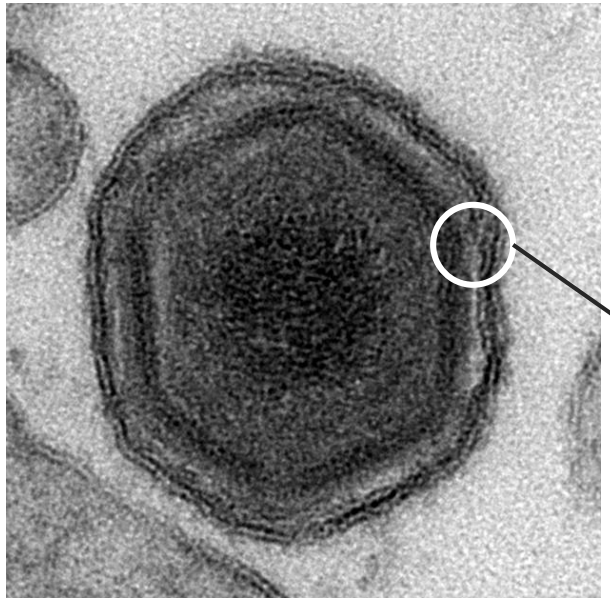
3D APPROACH
TO AFRICAN SWINE FEVER PREPAREDNESS 2018

BANGKOK (THAILAND) ● HO CHI MINH CITY (VIETNAM)

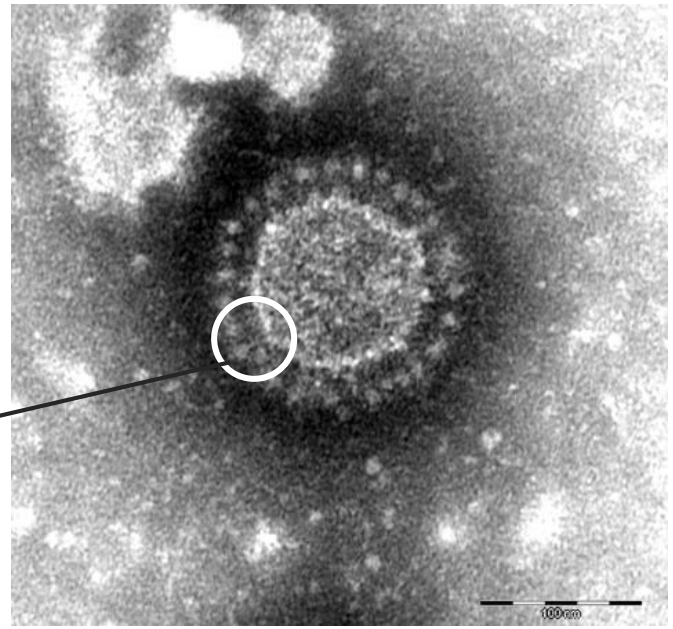
Enveloped Viruses *vs.* Non-enveloped Viruses



Electron micrograph of the African Swine Fever virus

Source:
https://en.wikipedia.org/wiki/African_swine_fever_virus#/media/File:African_swine_fever_virus_virion_TEM.jpg

Lipoprotein envelope derived from the membrane of the infected cells



Electron micrograph of the Porcine Epidemic Diarrhea virus

Source:
https://wwwnc.cdc.gov/eid/article/21/3/14-1165-f1

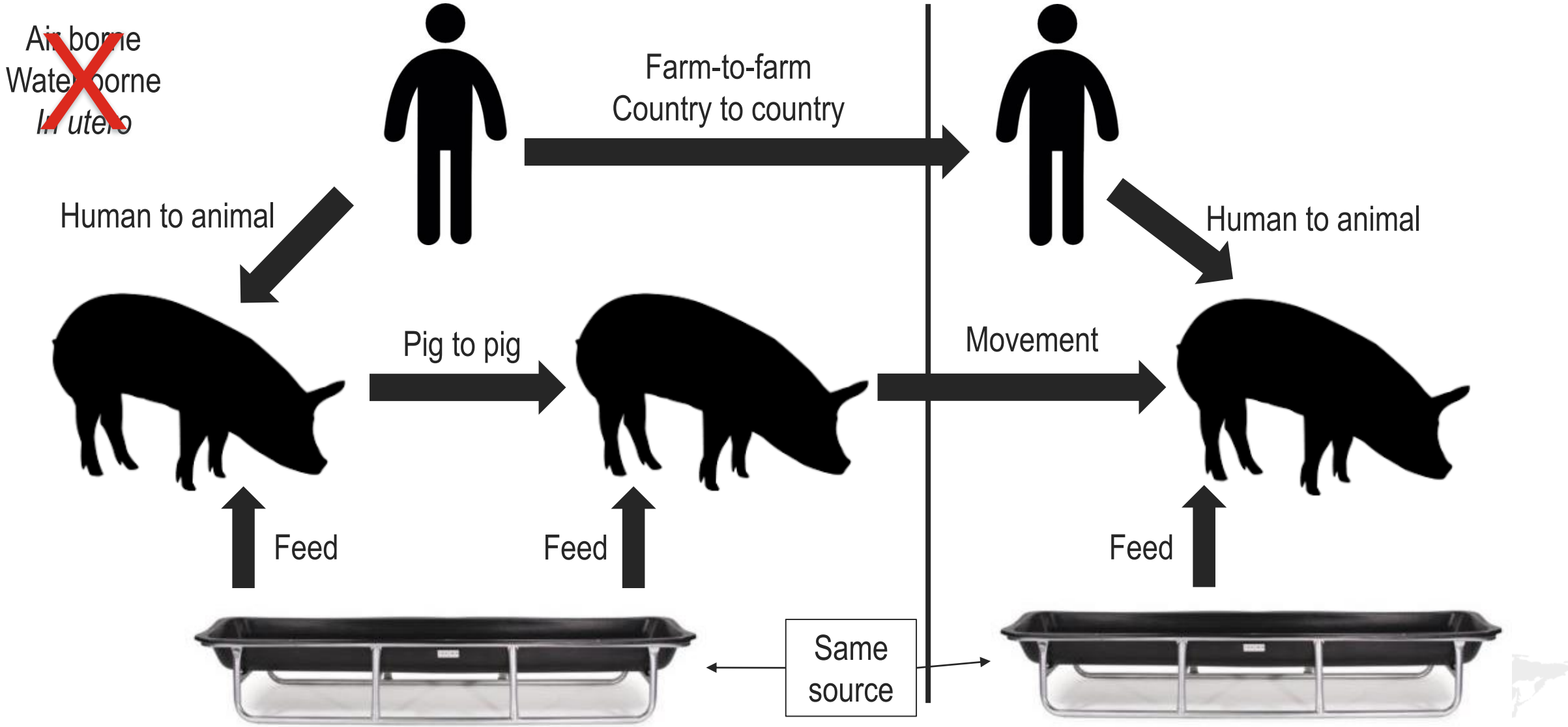
Enveloped Viruses *vs.* Non-enveloped Viruses

1. **Enveloped viruses** are generally to be highly stable and survive longer due to their adaptability to different environmental conditions

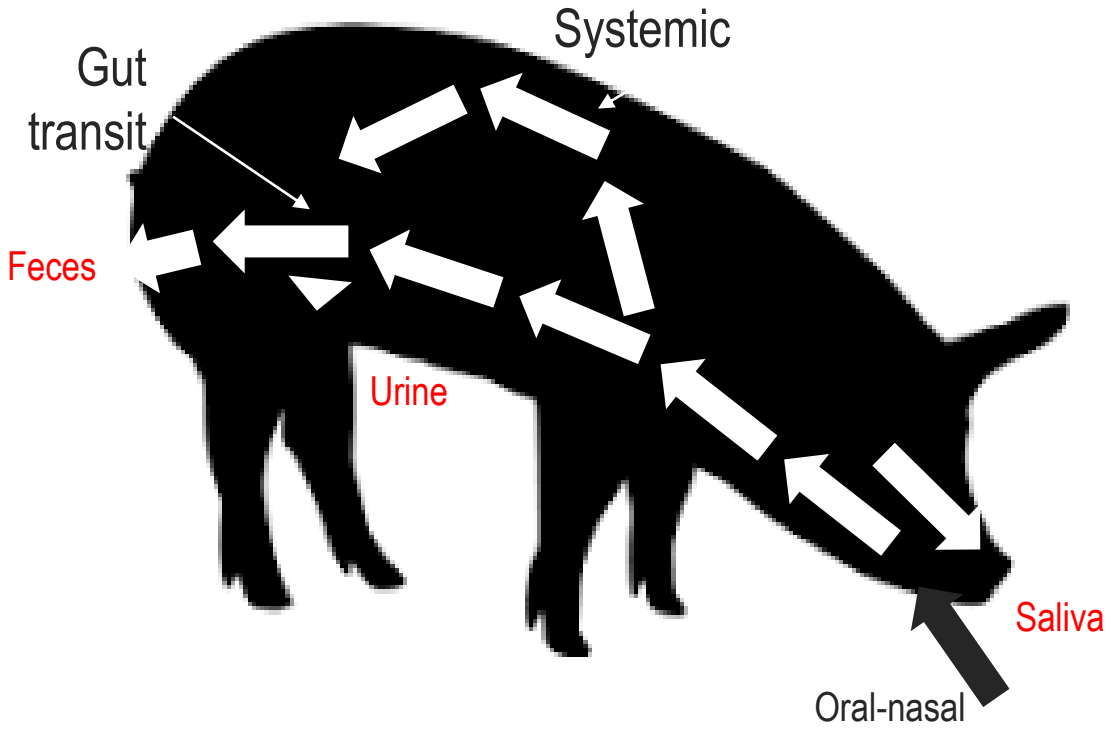
2. **Enveloped viruses** is sensitive to hot temperatures acidic environment, drying and formaldehyde

3. **Enveloped viruses** are potent at attacking the immune system, as they can quickly adapt their 'surface protein' to mask themselves: recurrent infection is high

African Swine Fever: Transmission



African Swine Fever: Infectivity



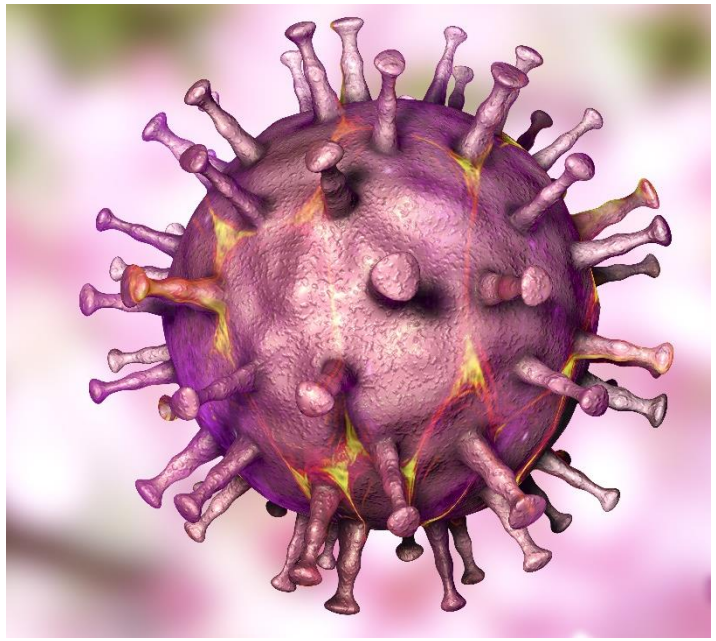
1. Oral-nasal route of infection

2. Shedding through excretion (feces) and secretion (urine, saliva)

3. Low infectious dose (especially for the genotype II which is highly virulent):
   a. *Morbidity within 1 day of direct contact*
   b. *Infection within 6 days if solid partition is present*
   c. *100% of animal infected within 9 days*
   d. *Oral route = 10^6 $TICD_{50}$ / ml*

Source:
https://veterinaryrecord.bmj.com/content/178/11/262

African Swine Fever: Virus Survivability



1. The virus can be inactivated at pH < 4 and pH >11:
   a. *Piglets are more susceptible because their gut is not yet fully developed*
   b. *The virus can survive in the gut because of the buffering effect of the feed*

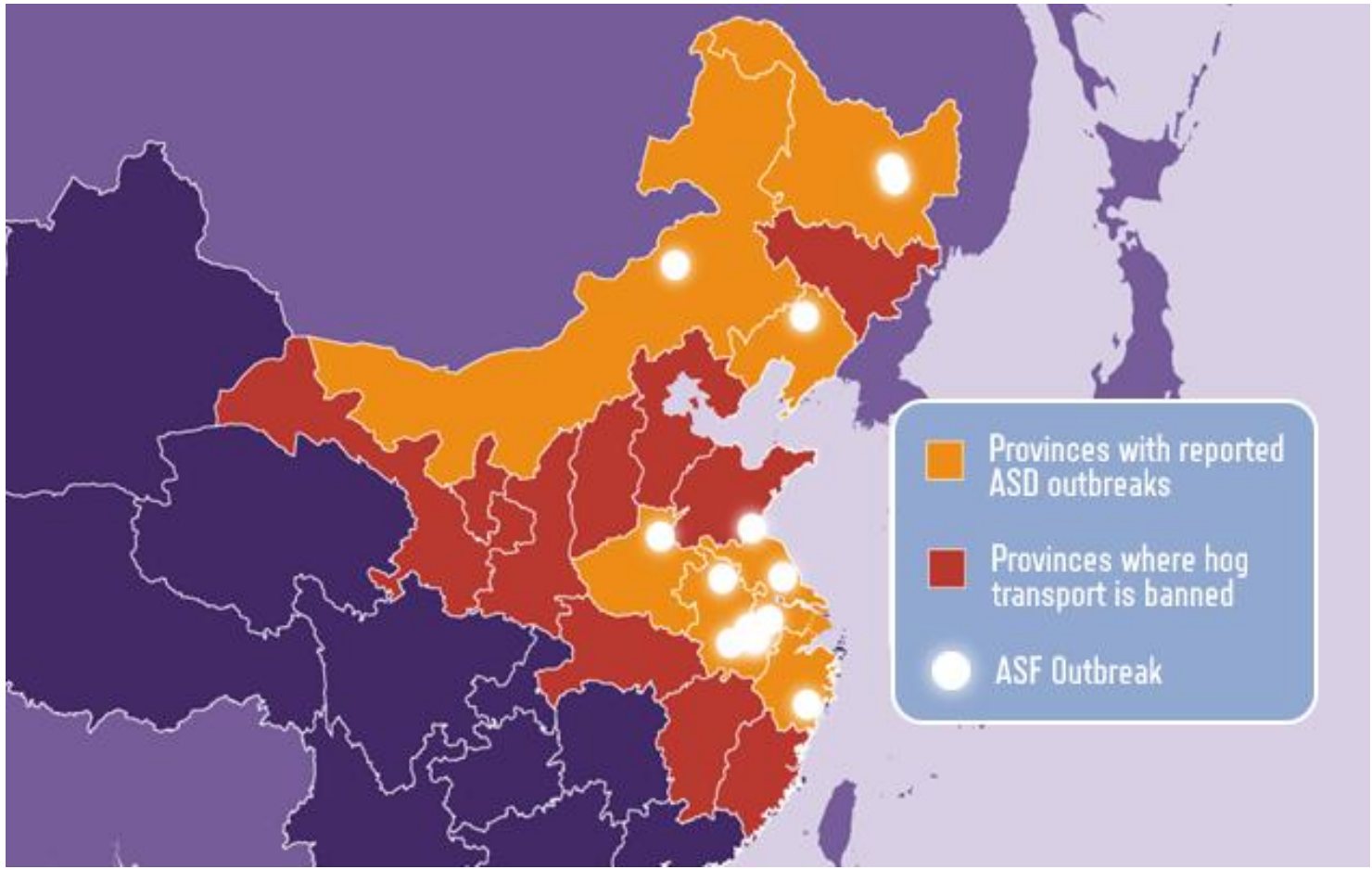
2. Survivability in the environment is temperature and moisture related:
   a. *Infectious half-life in urine and feces is 3 – 15 days at 37°C and 4 – 8 days at ≤4°C (In winter, pig houses are more than 4°C)*
   b. *The virus can survive much longer in the feed: research has shown that the holding time of 78 days is recommended for amino acids, vitamin and mineral premixes, and 286 days for soy bean meal, from manufacturing date*

3. The virus can survived for several weeks or months in uncooked as well as salted pork and offal. The virus is inactivated at >70°C. Typical pelleting temperature can inactivate the virus.

4. The virus can persist in pig carcass up to 6 months and in transboundary feed for more than 1 month

Sources:
1. https://www.vetmed.umn.edu/sites/vetmed.umn.edu/files/shmp_2018l19.8_african_swine_fever_transmission_-_science_page.pdf
2. https://www.allaboutfeed.net/Compound-Feed/Articles/2018/10/Feed-measures-to-potentially-reduce-ASF-spread-345770E/

African Swine Fever: Epidemic



1. As of 22 Oct 2018, China has reported more than 40 separate outbreaks of the ASF disease in **12 provinces** and municipalities since discovering its first case in August, leading to the culling of around 200,000 animals

2. China's three-month old outbreak of ASF has now spread for the first time to the country's south, its major pork-consuming region, signaling how **deeply the deadly disease has permeated the country's pig herd**, the world's largest

3. The curb on transport of animals within China has created significant dislocations in animal and/or pork supplies. Surplus pork is weighing on markets as producers rush to market healthy stock. At the same time, **prices in urban centers, along with regions in eastern and southern China, have seen as much as a 40% increase in prices**

4. China's Ministry of Agriculture and Rural Affairs declared on 25 Oct 2018 that it was **banning the feeding of kitchen waste (swill) to pigs** after linking the practice to the majority of the early cases of ASF

Source:

- https://research.rabobank.com/far/en/sectors/animal-protein/African_Swine_Fever_Shifts_Global_Protein_Picture.html
- https://www.theguardian.com/world/2018/oct/24/african-swine-flu-virus-threatens-pork-production-china-chinese-new-year

African Swine Fever: Prepardeness

FAO

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

1. Emergency Regional Consultative Meeting on ASF Risk Reduction and Preparedness was convened on 5-7 September 2018 in Bangkok, Thailand

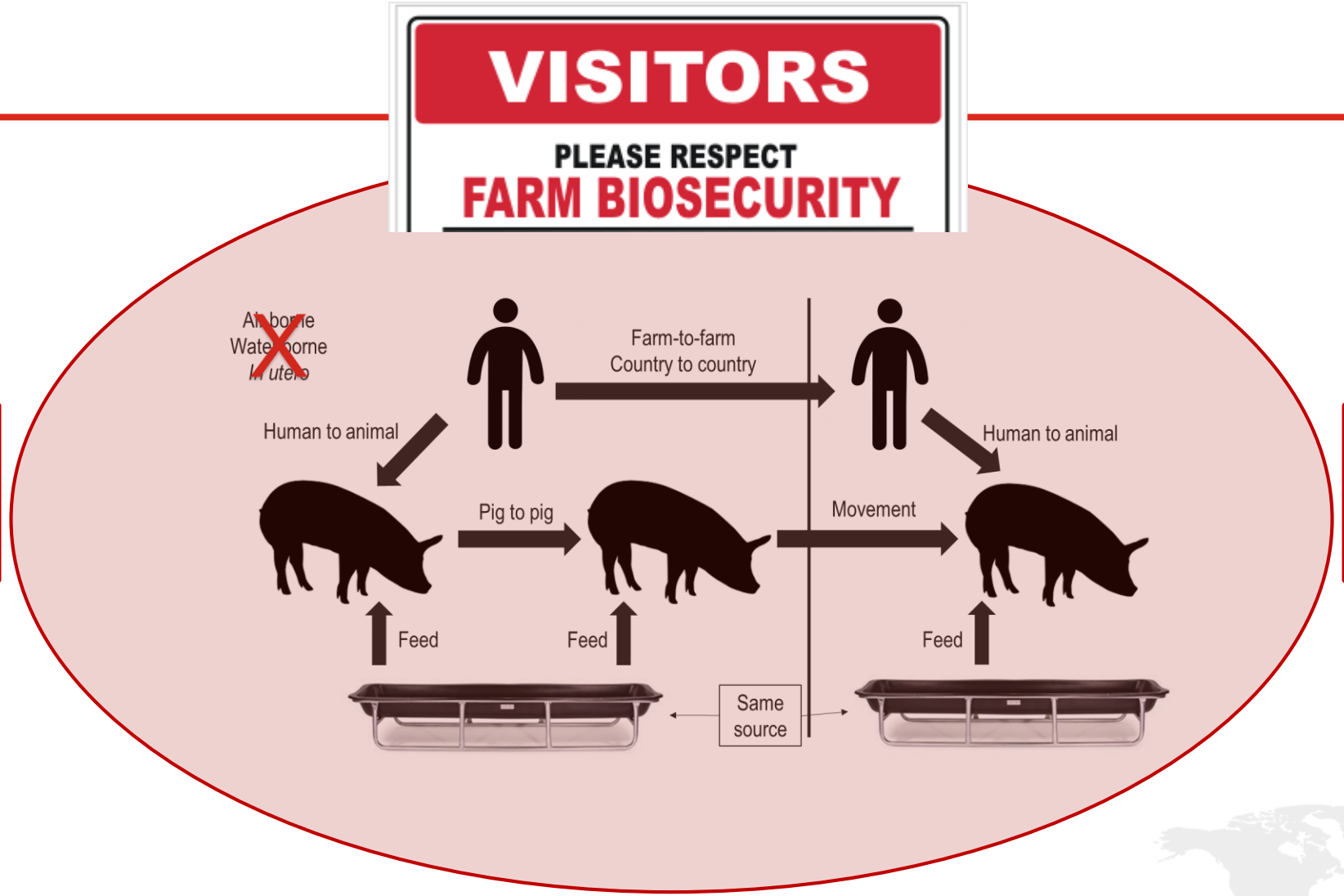
2. 87 representatives attended including FAO and OIE officials, Animal Health Authorities from East Asian countries and research institutes from the European Union

3. Objectives:
   a. Assess risk to China and the rest of the East Asian region
   b. Develop an inter-governmental approach towards ASF risk reduction, preparedness and response
   c. Identify priority actions for each country

Source:
http://www.fao.org/asiapacific/news/detail-events/en/c/1151566/

African Swine Fever: Mitigating The Risk of Transmission, Infection and Economic Loss

Trans-boundary



Herd Security

African Swine Fever: Mitigating The Risk of Transmission, Infection and Economic Loss

Only 10 out of 22 on-farm biosecurity measures are considered practical and effective:

1 – Active surveillance at abattoirs and rendering plants

2 – Intensive monitoring of neighboring herds

4 – Active surveillance of pigs at sentinel farms

7 – Syndromic surveillance of dead pigs

8 - Movement bans from neighboring herds

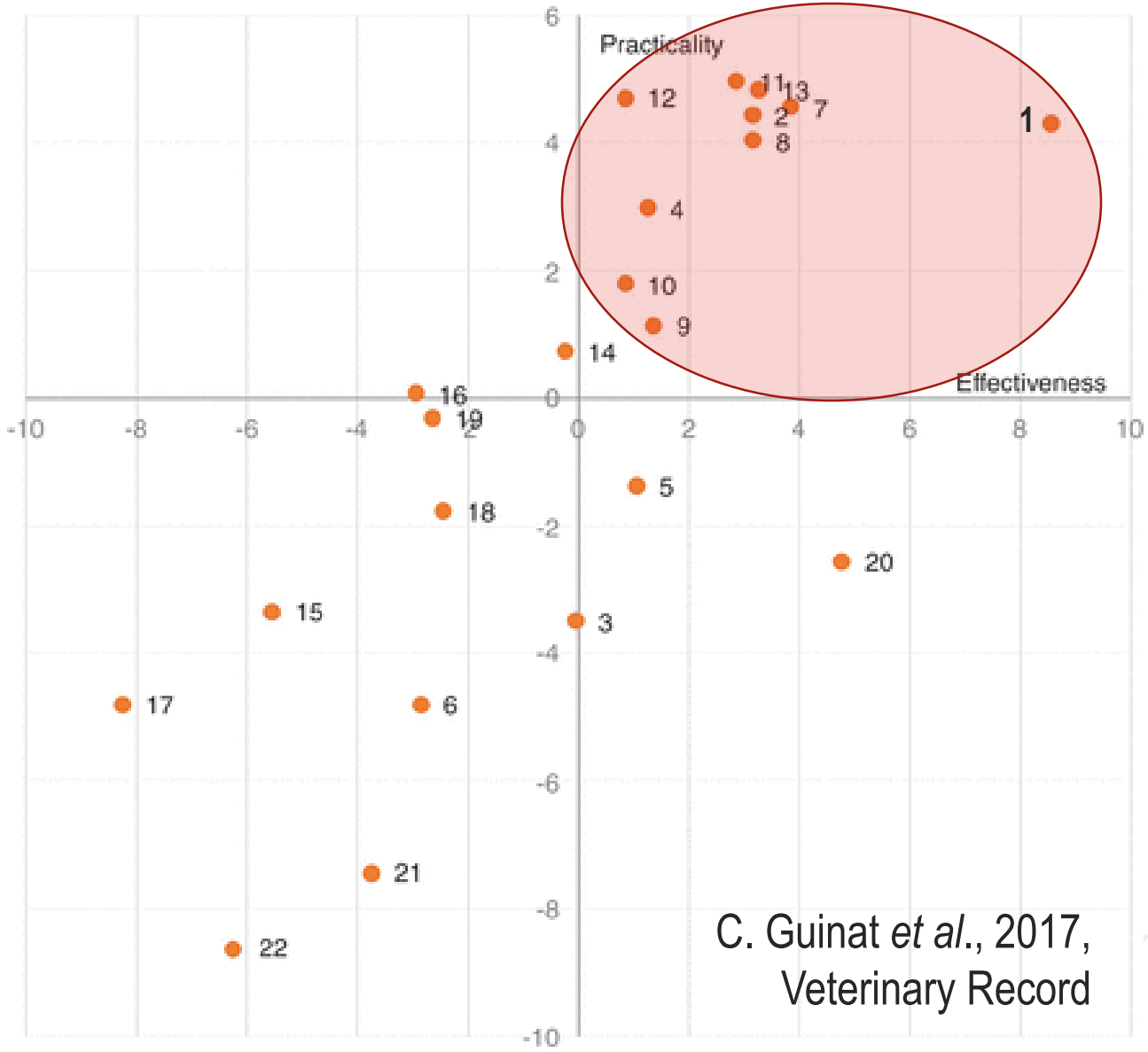
9 – Ban of swill feeding

10 – Thorough cleaning and disinfection of buildings

11 – Passive surveillance of sick pigs

12 – Farm entrance restrictions on people

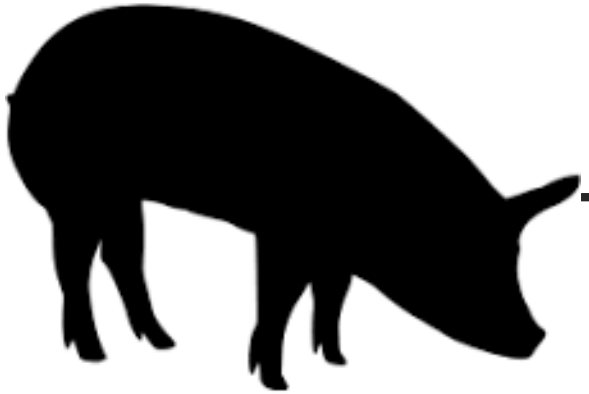
13 – Containment of pigs



C. Guinat *et al.*, 2017, Veterinary Record

Source:
https://veterinaryrecord.bmj.com/content/180/4/97 /

African Swine Fever: Mitigating The Risk of Transmission, Infection and Economic Loss

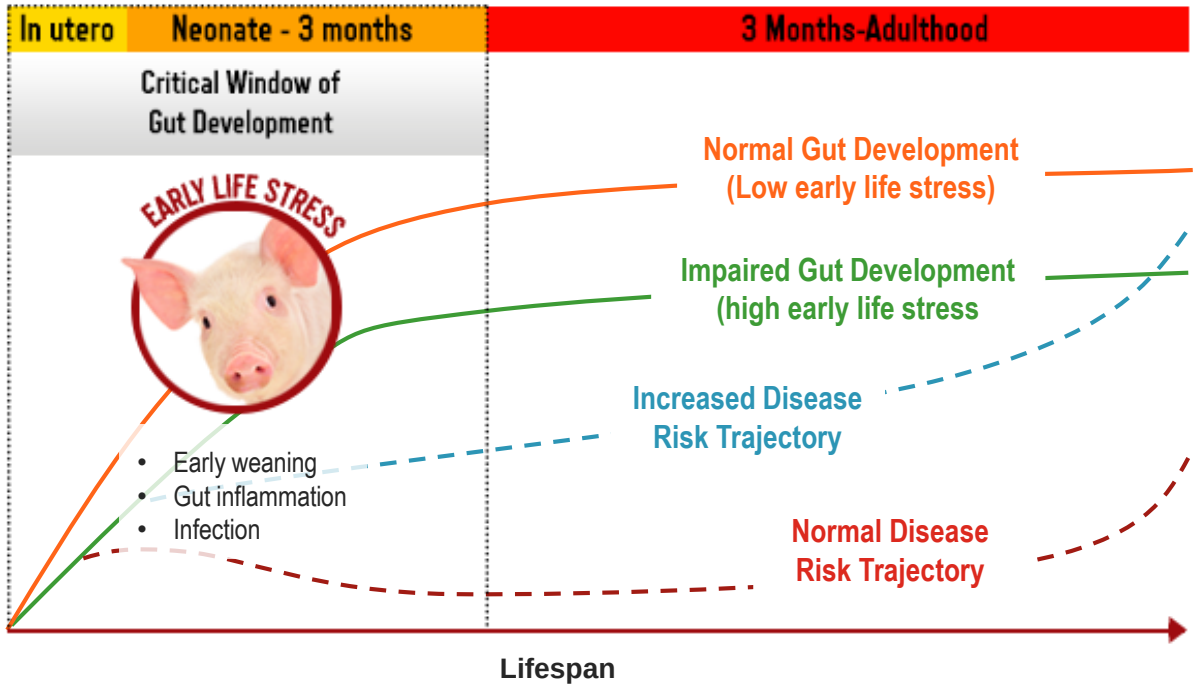


WHAT ABOUT THE PIG?

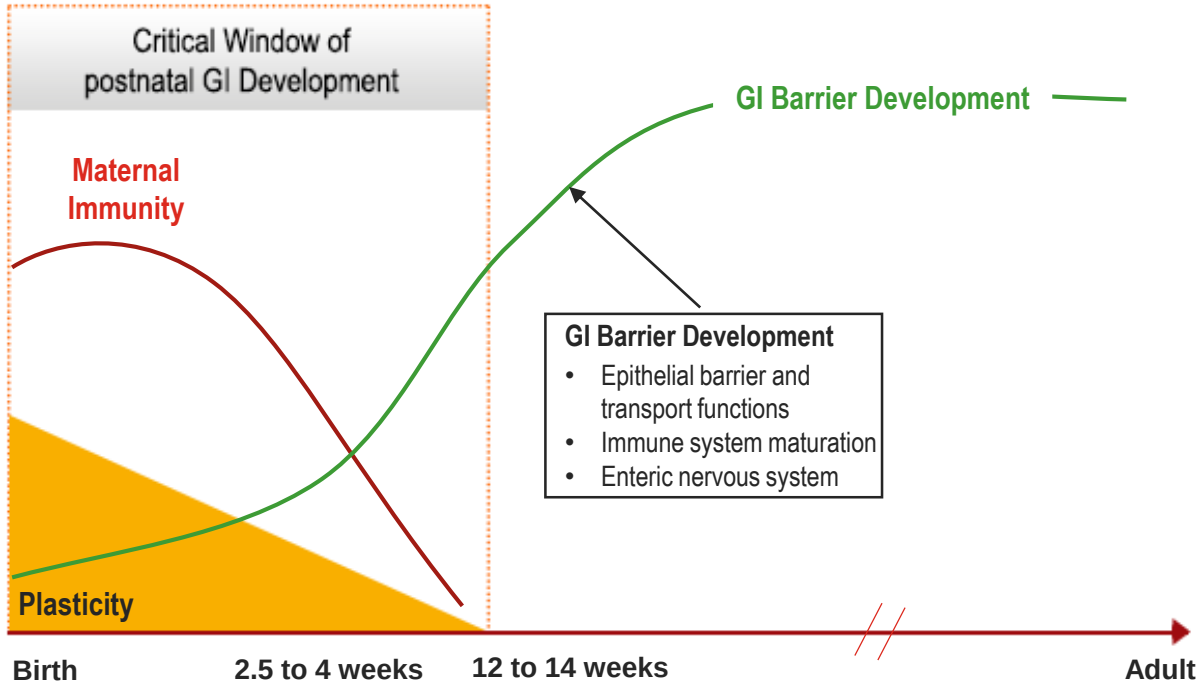
FEED (BIO)-SECURITY

IMMUNITY ENHANCEMENT

African Swine Fever: Mitigating The Risk of Transmission, Infection and Economic Loss

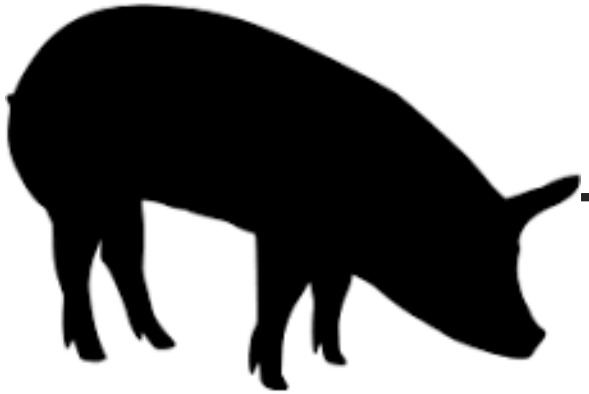


Source:
https://www.nationalhogfarmer.com/animal-health/gender-and-stress-matter-pig-gut-health



Source:
https://www.sciencedirect.com/science/article/pii/S2405654516302402

African Swine Fever: Mitigating The Risk of Transmission, Infection and Economic Loss

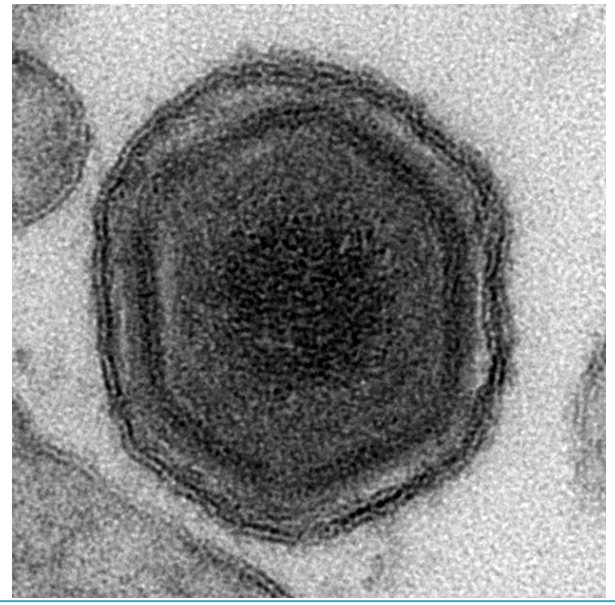


WHAT ABOUT THE PIG?

- FEED (BIO)-SECURITY
  - PATHOGEN LOAD REDUCTION
- IMMUNITY ENHANCEMENT
  - GUT IMMUNITY PRIMING

PATHOGEN LOAD REDUCTION

Pathogen Load Reduction (PLR)



Electron micrograph of the African Swine Fever virus

Source: https://en.wikipedia.org/wiki/African_swine_fever_virus#/media/File:African_swine_fever_virus_virion_TEM.jpg

FORMALDEHYDE-BASED BIOCIDE

Moderate doses in feed can inactivate enveloped viruses

ORGANIC ACID-BASED BIOCIDE

More research is needed to confirm efficacy

Formaldehyde-based Disinfectant

EFSA
European Food Safety Authority

Product		
Susceptible to ether and chloroform		http://www.oie.int/esp/maladies/fiches/e_A120.htm
Inactivated by 0.8% sodium chloride	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Hypochlorites - 2.3% chlorine	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
0.3% formalin	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
3 % ortho-phenylphenol	30 minutes	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Iodine compounds		http://www.oie.int/esp/maladies/fiches/e_A120.htm
Slurry addition to concentration of of 1 % NaOH or Ca(OH)2 at 4º C	1 minute	http://www.oie.int/esp/maladies/fiches/e_A120.htm
Slurry addition to concentration of 0,5 % NaOH or Ca(OH)2 at 4º C	30 minutes	Turner and Williams, 1999
Environ (1/E) (o-phenylphenol) 1 %	1 hour	Stone and Hess 1973

Source:
EFSA Journal 2010; 8(3):1556

Formaldehyde-based Biocide

Sal CURB®

Publication in BMC Veterinary Research (2014), 10:220

Conclusion of authors:

1. The study demonstrated that feed treated with a liquid formaldehyde-based product can serve as a means to reduce the risk of PEDV (an enveloped virus) infection through contaminated feed
2. The results from the positive control group provide additional proof of concept regarding the ability of contaminated feed to serve as a risk factor for PEDV infection of naïve piglets.

Source:
Scott Dee et al. Porcine Health Management (2015) 1:9
DOI 10.1186/s40813-015-0003-0

Formaldehyde-based Biocide

Sal CURB®

Publication in Porcine Health Management, (2015), 1:9

Conclusion of authors:

1. The study demonstrated that PEDV viability in feed was influenced by the different types of feed ingredients used with extended survival in Soy Bean Meal
2. The study further confirmed that the liquid formaldehyde-based antimicrobial rendered PEDV inactive, **independent of ingredient type used in the feed**

Source:
Scott Dee et al. BMC Veterinary Research (2016) 12:51
DOI 10.1186/s12917-016-0674-z

Pathogen Load Reduction (PLR)

Formaldehyde-based Biocide

Advanced Formulation of Sal CURB™ RM E Plus Liquid *

Highly Concentrated Source of Formaldehyde (33%)

Cost effective in inhibiting and inactivating pathogens through irreversible cross-linkages of proteins

Slow Release Formaldehyde Formulation

Effective in preventing and safeguarding feed from recontamination

Advance Surfactant Technology

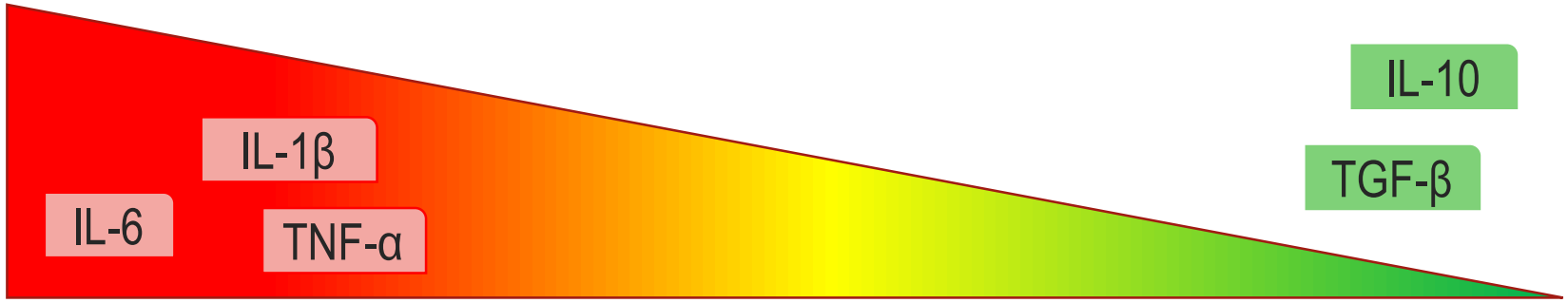
Enhances the spread and penetration of the actives into feed matrix for maximum pathogen inhibition

* Recommended application rate : 2-3 kg/MT to mitigate ASF risk

GUT IMMUNITY PRIMING

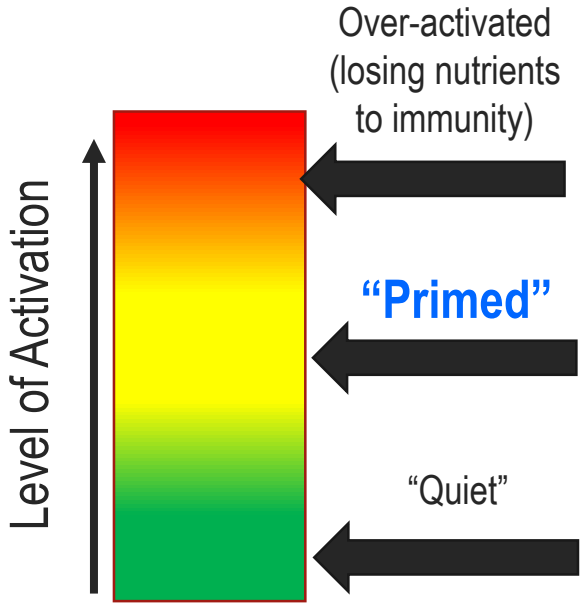
Beta 1,3 Glucan: Priming Agent

Different Cytokine and Chemokines Are Used to Get the Response You Want

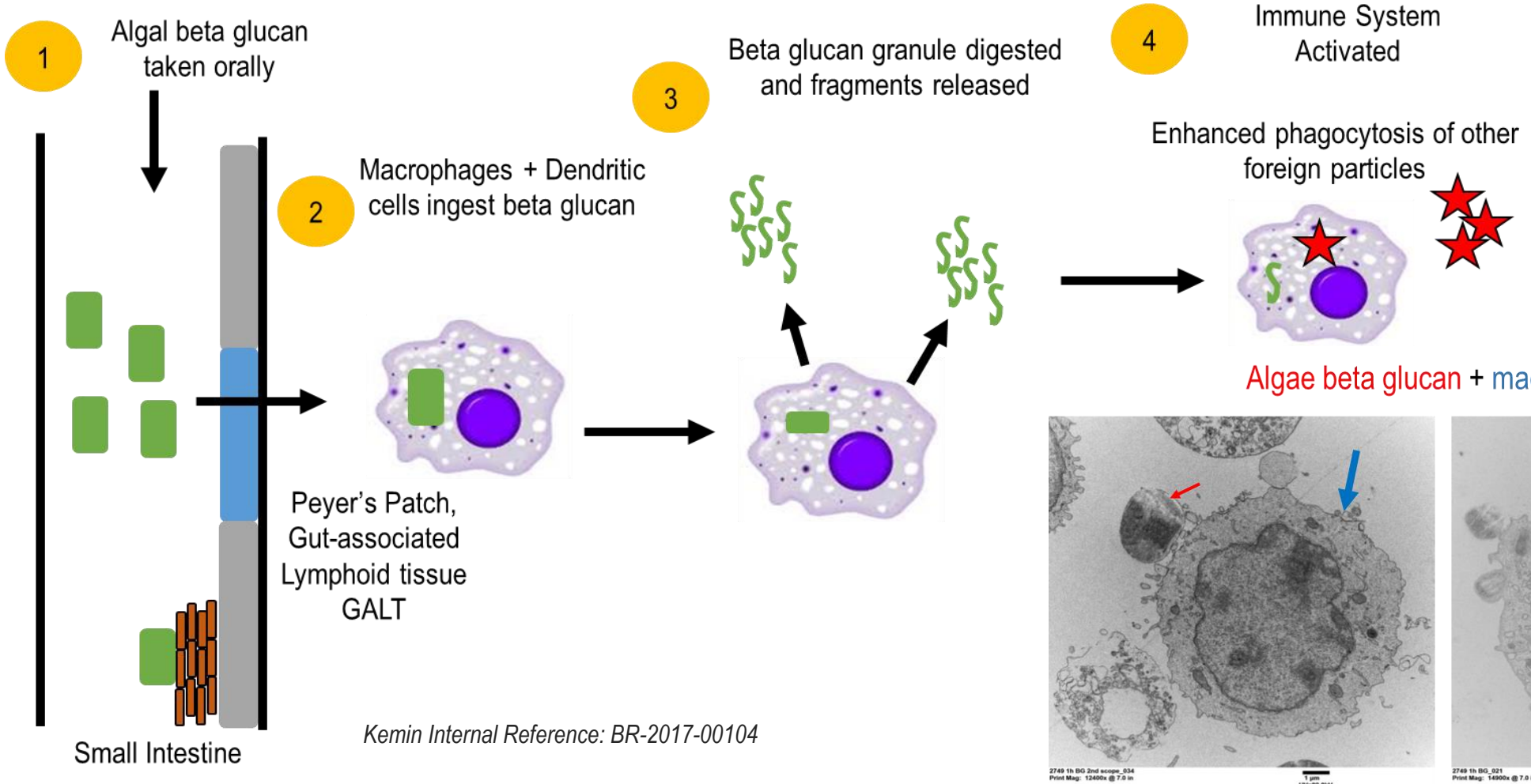


Pro-Inflammatory: induce inflammation

Anti-Inflammatory: minimize inflammation



Beta 1,3 Glucan: Priming Agent



Kemin Internal Reference: BR-2017-00104

Algae beta glucan + macrophage

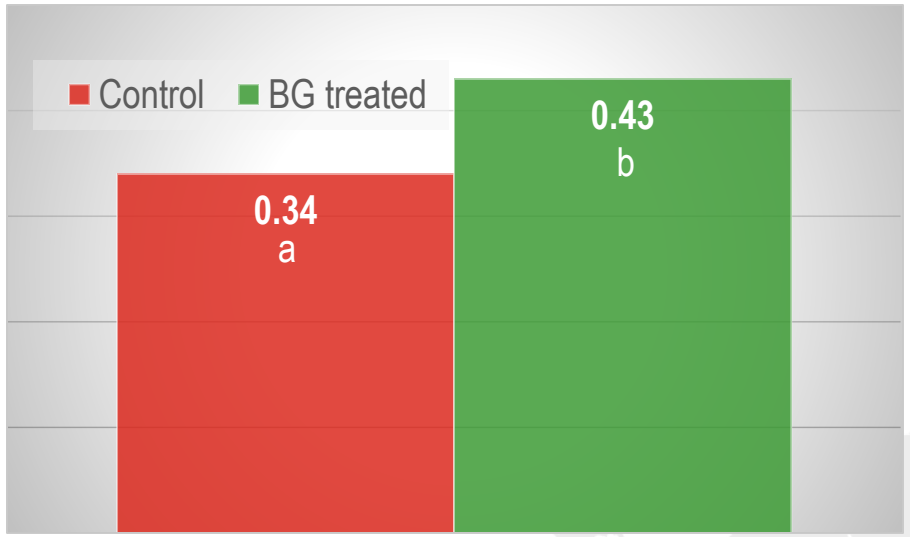
Gut Immunity Priming (GIP)

Beta 1,3 Glucan: Priming Agent

DoE: 80 three-week-old piglets were randomly allotted to 2 treatments with 10 pens per treatment and 4 pigs per pen, and fed experimental diets for 35 days. Three phase diets were applied according to piglets' age. Treatments consisted of a negative control and an BG-treated group consisting of the negative control supplemented with 200 g / MT of BG. Blood was taken on day 30 to evaluate the effect of BG on the immune status, by measuring IgA and TNF-α levels.

TNF-α
$p < 0.05$

IgA
$p < 0.05$



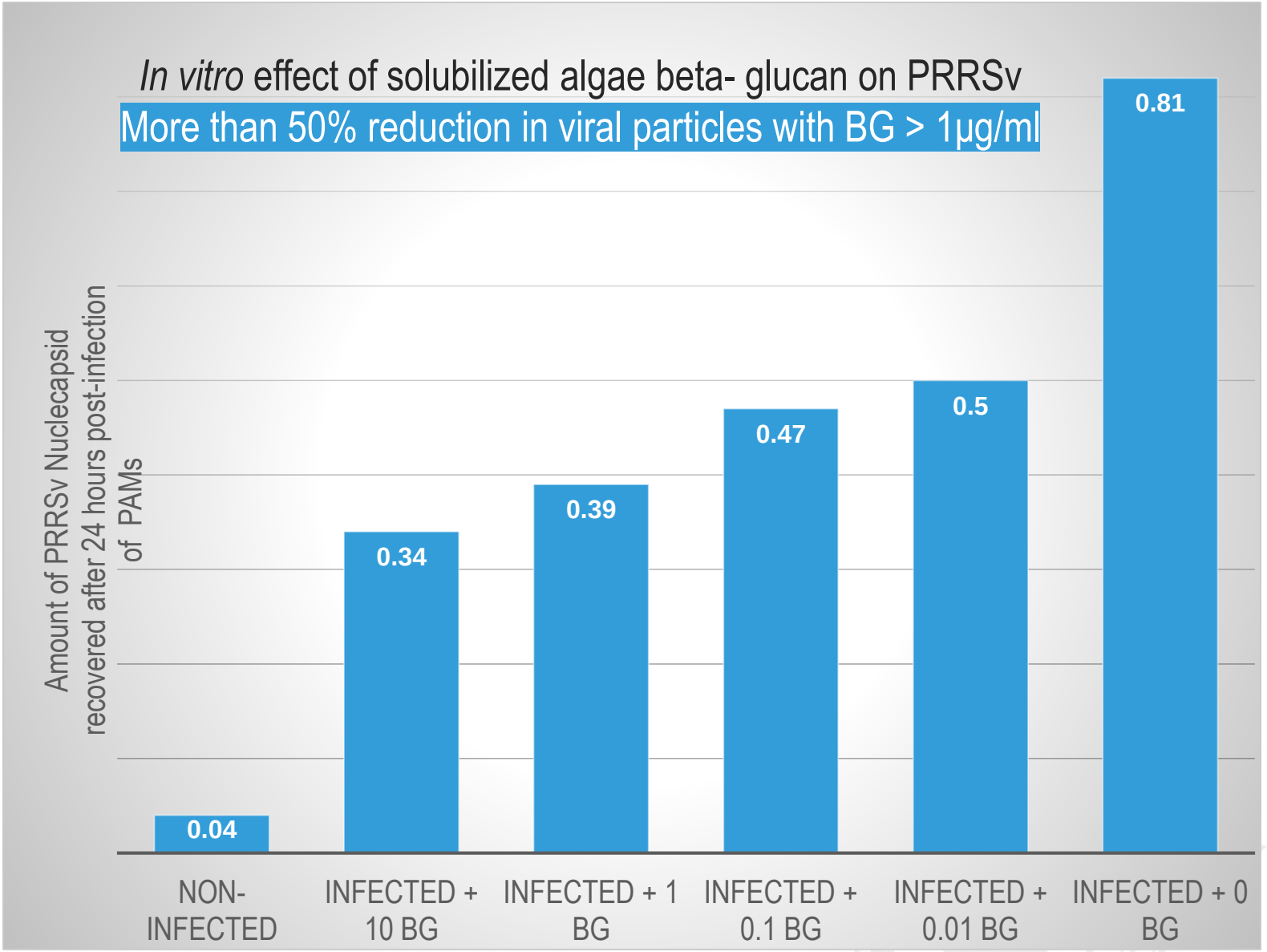
Kemin Internal Reference: TL-17-00067

Gut Immunity Priming (GIP)

Beta 1,3 Glucan: Priming Agent

DoE: The study evaluates the impact of an experimental solubilized β-1,3-glucan (BG), on PRRSv infection and growth on porcine alveolar macrophages (PAMs) *in vitro*. PAMs were cultured, treated with ten-fold dilutions of BG from 10 µm/mL to 0.01 µm/mL, and infected with PRRSv. Infected PAMs were not treated with BG. Non-infected PAMs acted as negative control. Supernatants were collected at 0, 12, 24 and 36 hours. The impact of BG was measured by qRT-PCR for viral growth and by flow cytometry for viral infection. BG reduced the growth of PRRSv in a dose-dependent fashion and this effect was consistently achieved over three replicates.

Kemin Internal Reference: SD-17-00061

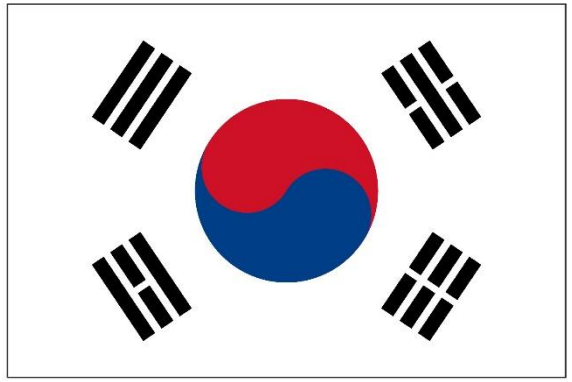


Beta 1,3 Glucan: Priming Agent

SWINE TRIAL:

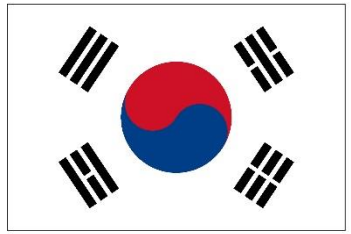
- Number of animal: 63 weaning piglets
- Start Day: Day 21 (post weaning)
- Place: 5000 pig farm size in Gyung Gi Province, South Korea
- Treatment period: 32 days (**4th Jan 2018 to 6th Feb 2018**)

Control	Standard feed
Treatment 1	Standard feed with essential oil @ 1,000 g/MT
Treatment 2	Standard feed with BG @ 200 g/MT



Kemin Internal Reference: SD-18-00046

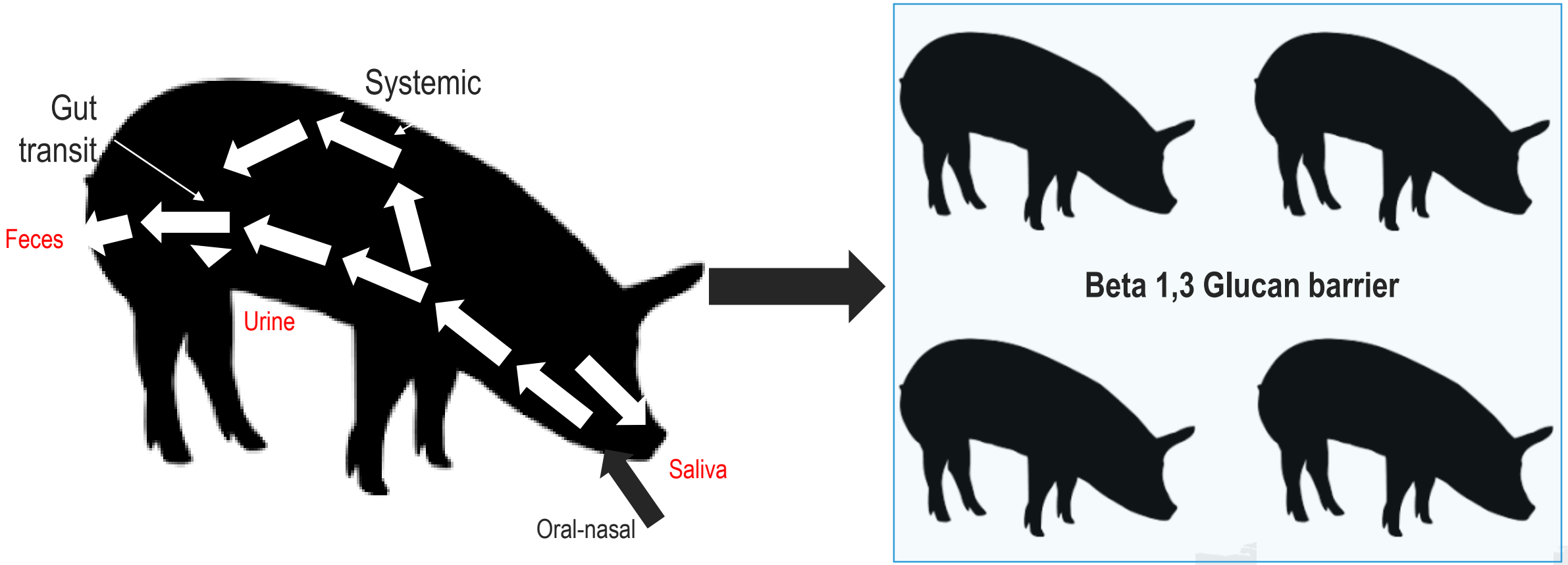
Beta 1,3 Glucan: Priming Agent



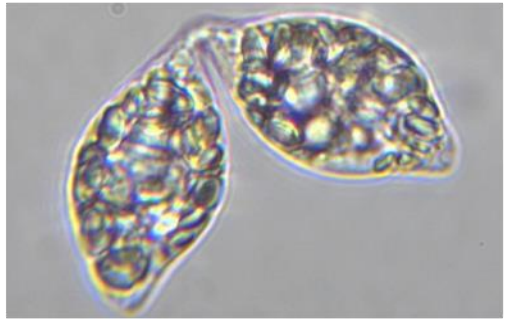
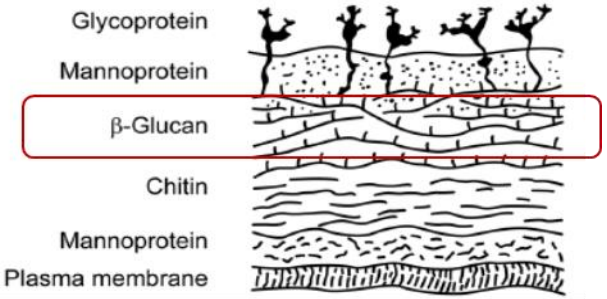
Parameters Measured	Control (C)	Treatment 1 (T1)	Treatment 2 (T2)	Difference (T2 - C)
Number of pigs	21	21	21	-
Total initial body wt. (kg)	178	177	178	n.d.
Total final body wt. (kg)	349	367	387	11%
Total feed intake (kg)	232	264	266	15%
Total body wt. gain (kg)	171	190	210	23%
Average daily gain (kg)	5.34	5.94	6.56	1.22
FCR	1.36	1.39	1.27	-7%

Kemin Internal Reference: SD-18-00046

Beta 1,3 Glucan: Priming Agent



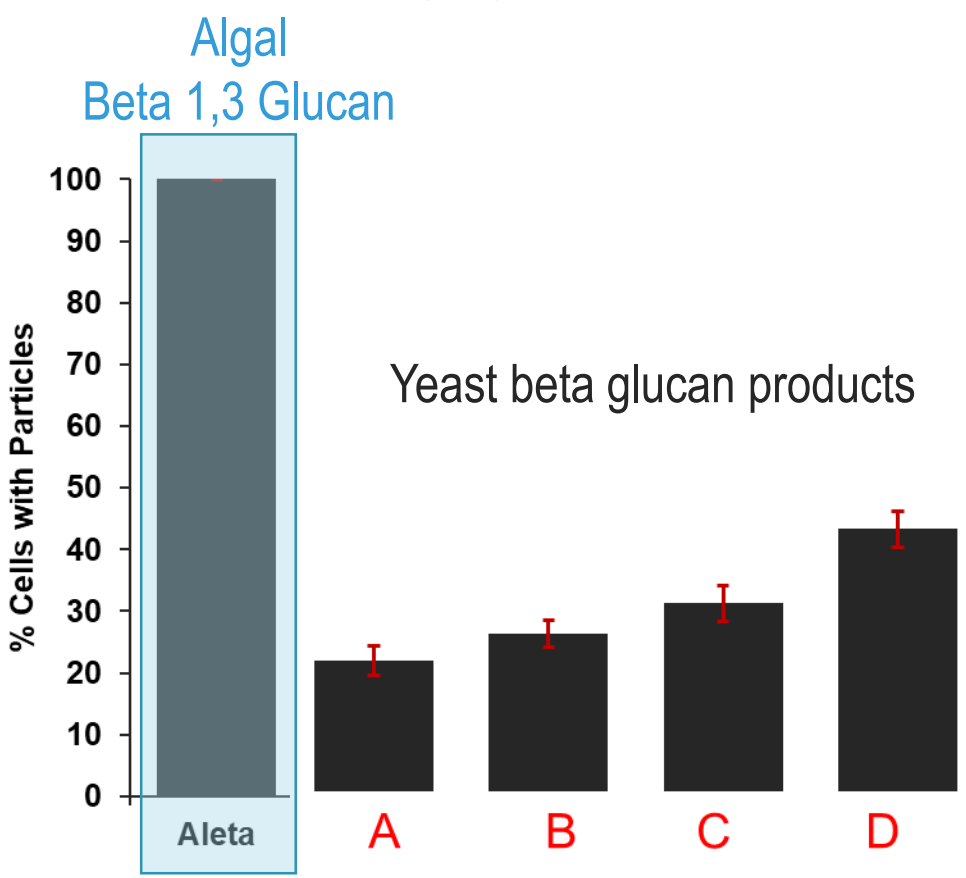
Beta 1,3 Glucan: Priming Agent

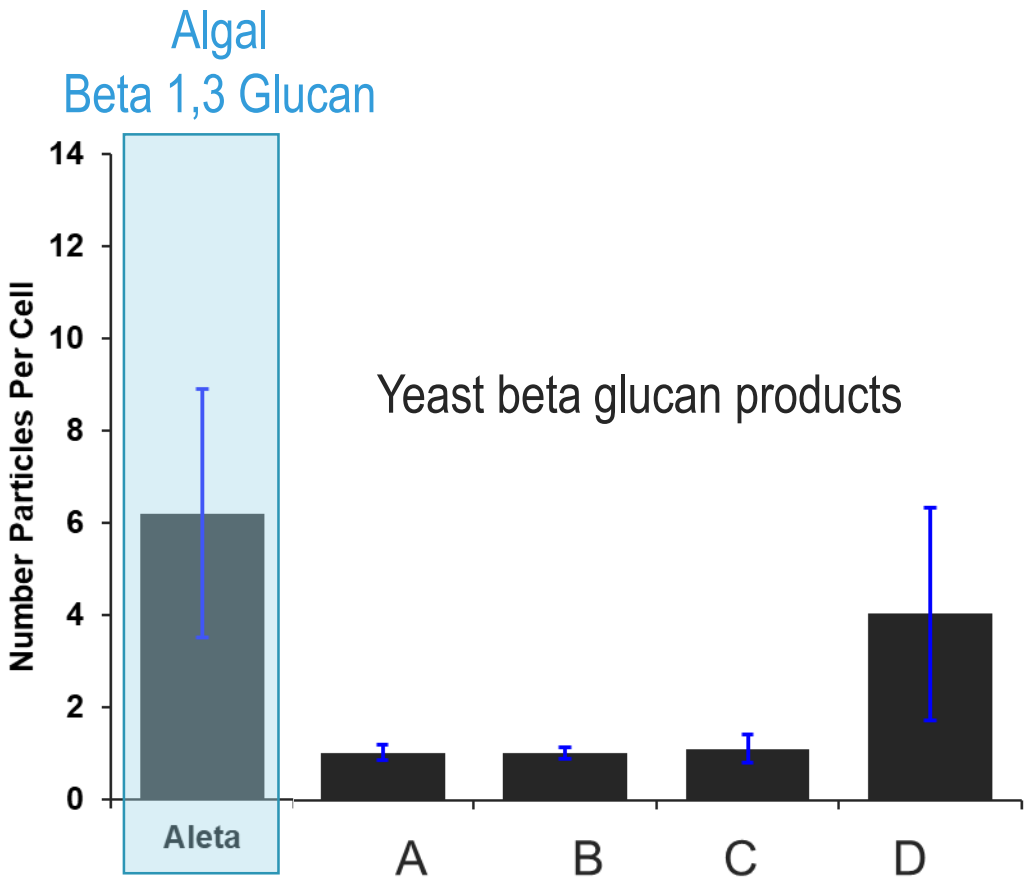
	Algae Beta Glucan (Aleta)	Yeast beta glucan
Different forms of beta glucan		
Percent of beta glucan in raw material	> 50%	5% - 15%
Form of beta glucan	Over 90% as linear 1,3 form	Less than 80% as linear 1,3, lots of 1,6 side branches
Bio-availability	Active in dried algae	Extraction required
Particle size	Ideal: small 1-3 micron	Large and variable, > 10 micron

Journal of Hematology & Oncology 2009, 2:25

Gut Immunity Priming (GIP)

Beta 1,3 Glucan: Priming Agent





Kemin Internal Reference: TD-17-00307

3-D APPROACH

PREPAREDNESS

THANK YOU!