

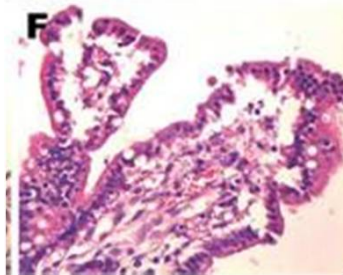
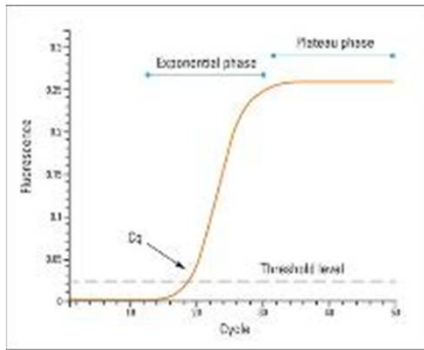
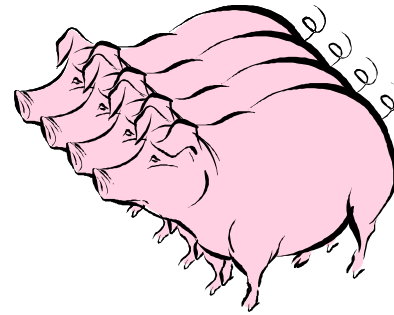


ASFV in Feed and Feed Ingredients: Relative Risk, Determination and Mitigation Strategies

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- University of Minnesota

Pinoy Pork Challenge 2023

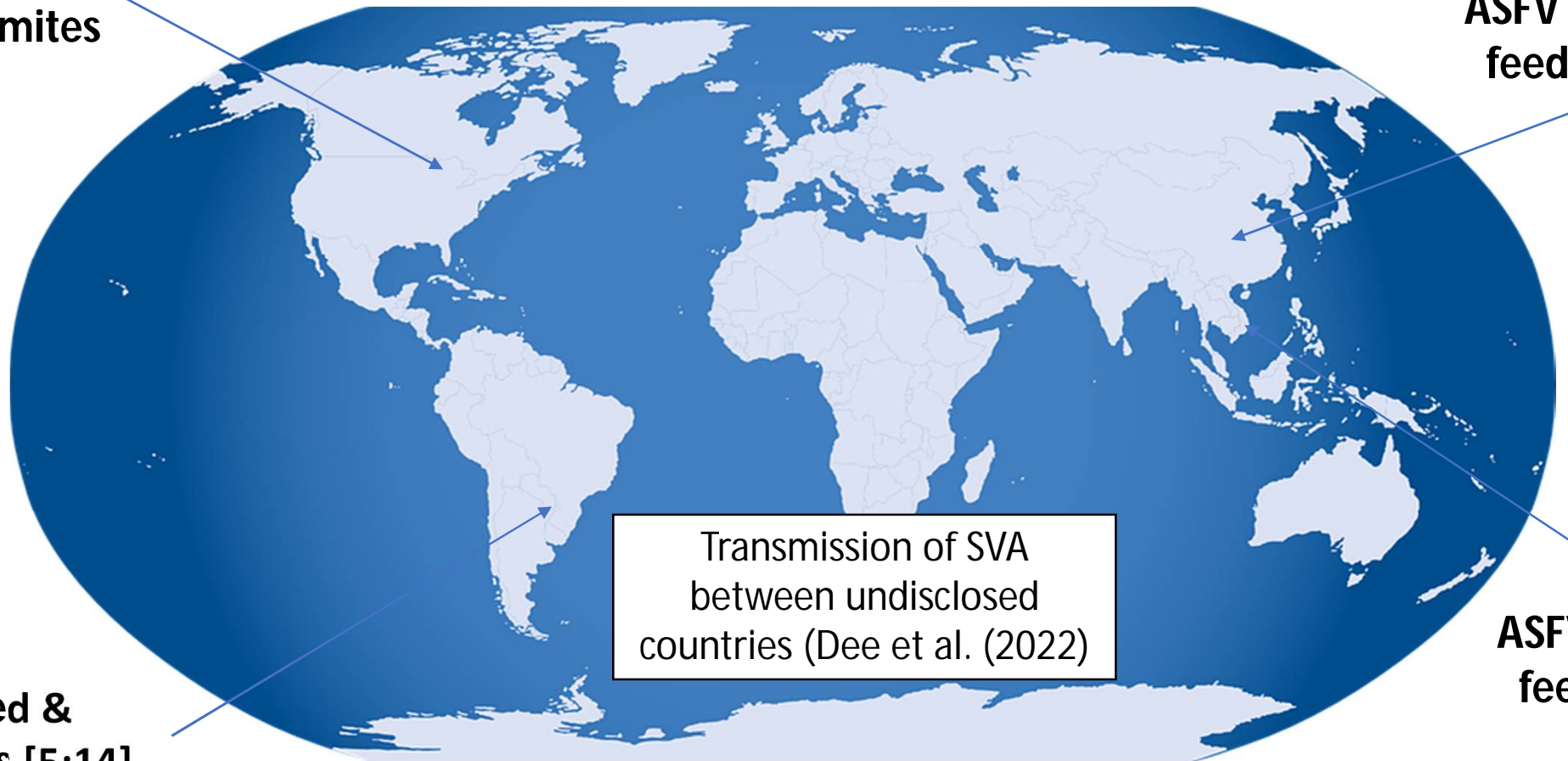
Virus (PCR positive samples) contamination of feed



virus contaminated feed, ingredients, and equipment are associated with outbreaks of diseases

- feed bins,
mill fomites

ASFV – com
feed [30:2



VV feed &
redients [5:14]

ASFV – co
feed [30:

Viruses survival in feed after 39 days (Dee et al. 2018)

| Ingredient | SVA (FMDV) | ASFV | PSV (SVDV) | PEDV | FCV (VESV) | PCV2 | BHV-1 (PRV) | PRRSV 174 | BVDV (CSFV) | VSV | CDV (NiV) | IAV-S |
|---------------------------|------------|------|------------|------|------------|------|-------------|-----------|-------------|-----|-----------|-------|
| Soybean meal-Conventional | (+) | (+) | (+) | (+) | (+) | (-) | (+) | (+) | (-) | (-) | (-) | (-) |
| Soybean meal-Organic | (-) | (+) | (+) | (+) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |
| Soy oil cake | (+) | (+) | (+) | NT | (-) | (-) | (+) | (-) | (-) | (-) | (-) | (-) |
| DDGS | (+) | (-) | (-) | NT | (-) | (-) | (-) | (+) | (-) | (-) | (-) | (-) |
| Lysine | (+) | (-) | (+) | (+) | (+) | (+) | (-) | (-) | (-) | (-) | (-) | (-) |
| Choline | (+) | (+) | (-) | (+) | (-) | (+) | (-) | (-) | (-) | (-) | (-) | (-) |
| Vitamin D | (+) | (-) | (+) | (+) | (-) | (+) | (-) | (-) | (-) | (-) | (-) | (-) |
| Moist cat food | (+) | (+) | (+) | NT | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |
| Moist dog food | (+) | (+) | (+) | NT | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |
| Dry dog food | (+) | (+) | (+) | NT | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |
| Pork sausage casings | (+) | (+) | (+) | NT | (+) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |
| Complete feed (+ control) | (+) | (+) | (+) | NT | (+) | (+) | (-) | (-) | (-) | (-) | (-) | (-) |
| Complete feed (- control) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |
| Stock virus control | (-) | (+) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) | (-) |

Dee et al. (2018)

Hazard vs. risk, the difference

A hazard has the potential to harm or adverse effects to human, animals, or environment

Risk is the *likelihood* of a hazard causing *harm*

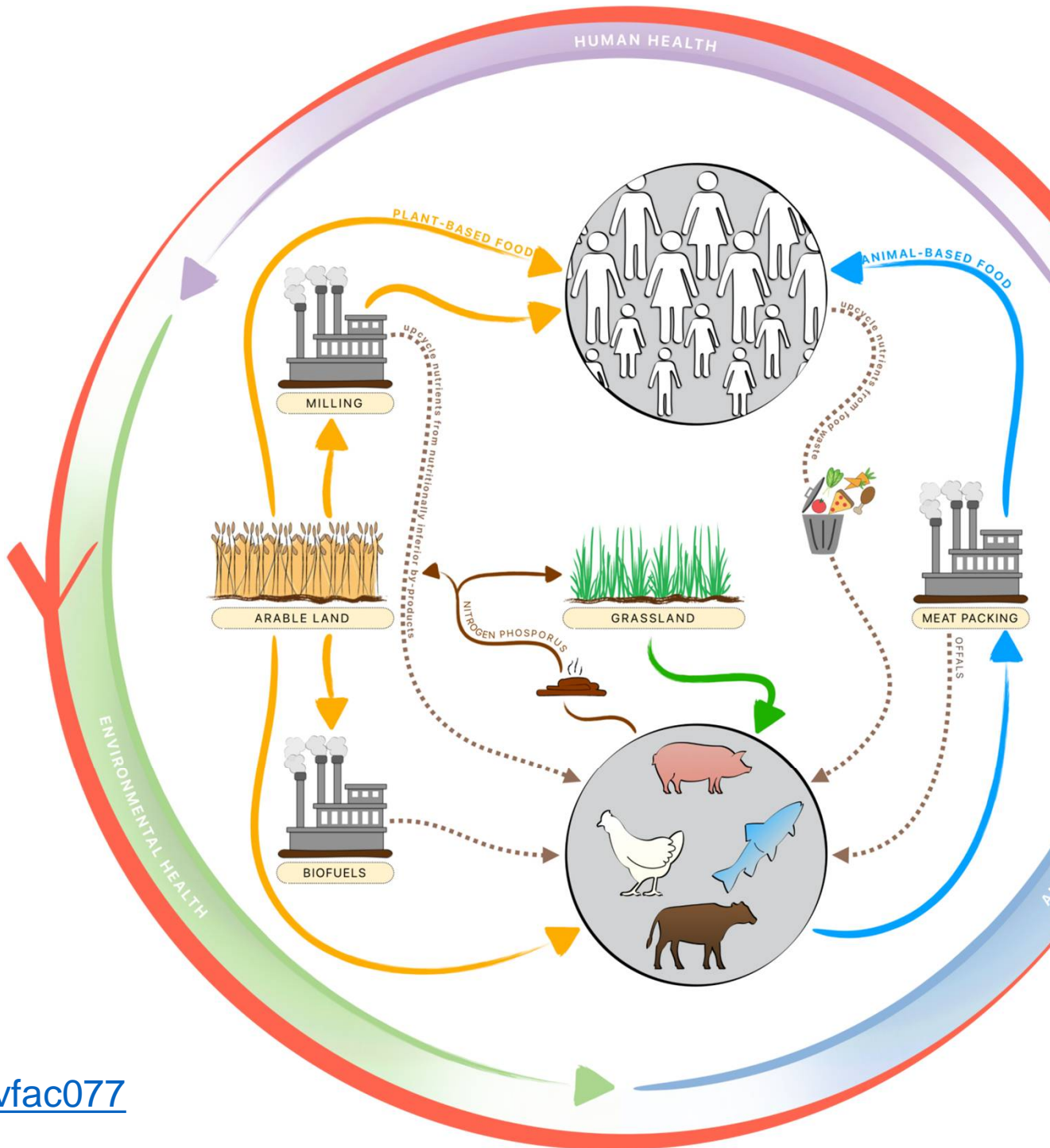
The difference is exposure

Not so black and white.

Therefore, we need to do risk assessments!

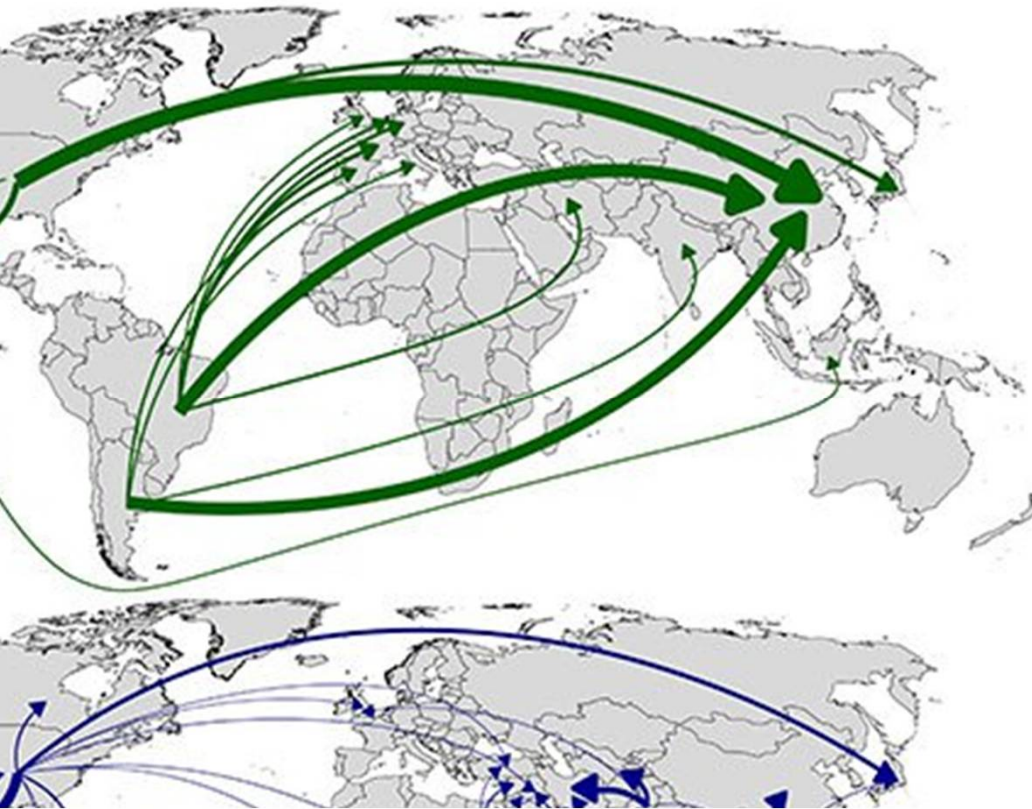


Consumer
demanding foods
with more
attributes



and Urriola (2023) doi.org/10.1093/af/vfac077

Trade is essential to sustainable foods



Control of ASF includes the entire pork supply chain

PHILIPPINE COLLEGE OF
SWINE PRACTITIONERS

Home

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PINOY PORK CHALLENGE

FEATURED

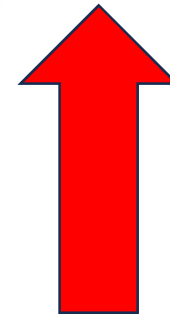
NEWS

PUBLICATIONS

ABOUT US

PCSP Position regarding ASF management and control and on ASF vaccines

PCSP believes that ASF can be prevented and controlled by implementing strict Biosecurity / Biocontainment in areas, farms and other swine related facilities (feed mills, slaughterhouses, etc.).



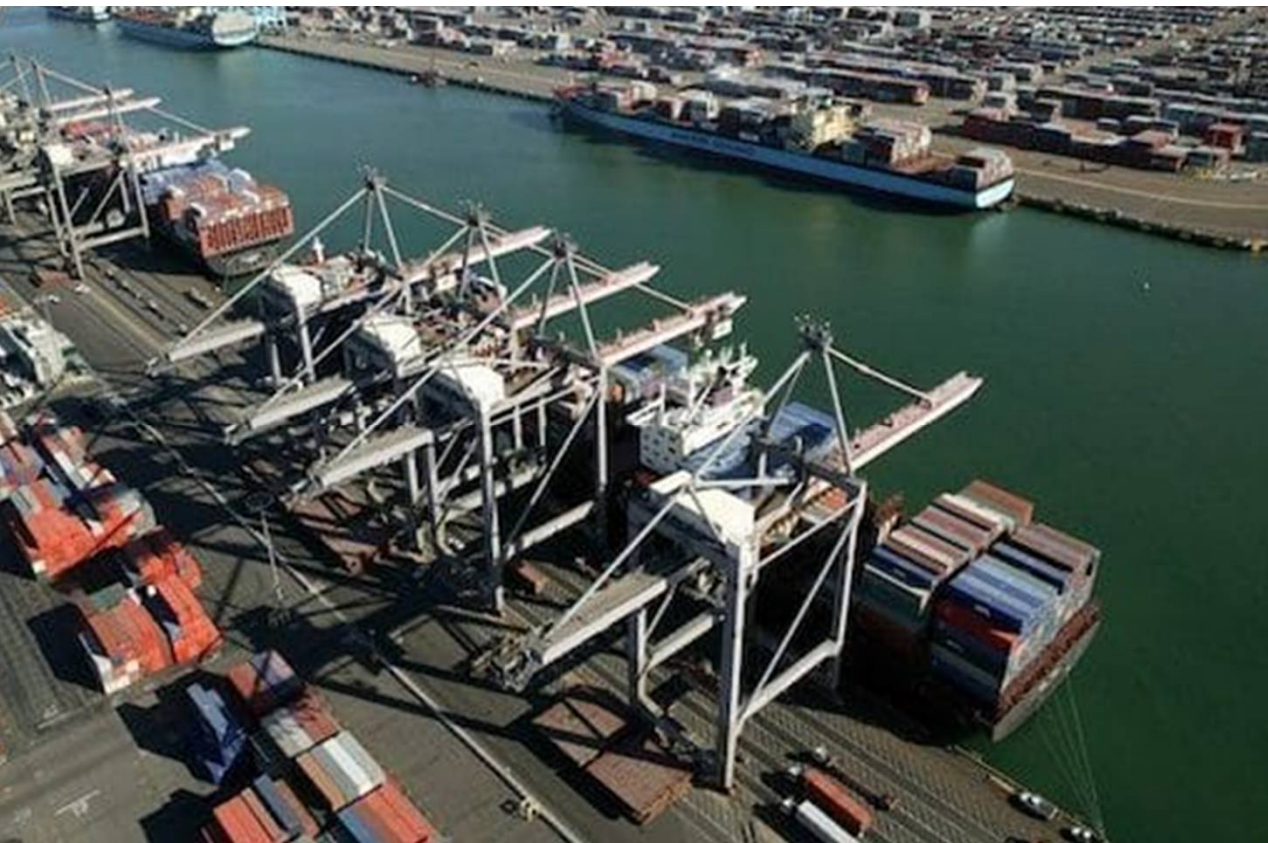
Actions to prevent and mitigate feed contamination



Feed low likelihood of transmission but must be addressed



Mitigation must include prevention.



Quantitative risk
assessments
suggest low risk of
AV in feed
ingredients

- Imported feed ingredients:
 - Cereal grains
 - Oilseeds
- Animal derived feed ingredient
 - Spray drying porcine plasma

Guidelines for developing risk-based preventative control procedures for pathogens from imported feed ingredients

Schettino¹, J. L. G. van de Ligt², F. Sampedro², G. C. Shurson²,
 Cassandra Jones⁴, and P. E. Urriola¹

¹Veterinary Population Medicine, College of Veterinary Medicine,

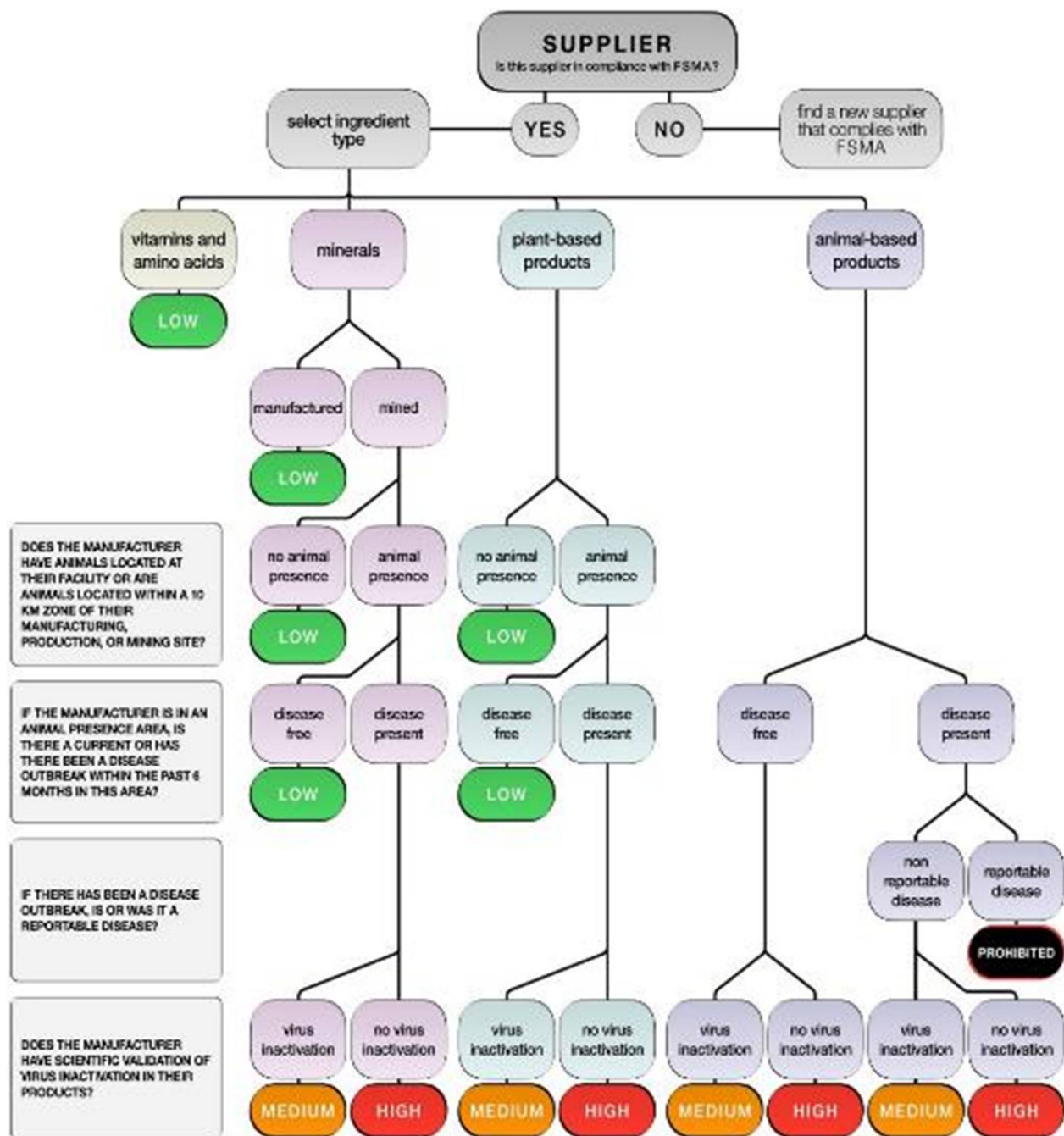
University of Minnesota. ²Environmental Health Sciences

Department, School of Public Health, University of Minnesota.

³Department of Animal Science, College of Food, Agriculture and

Natural Resources Sciences, University of Minnesota.

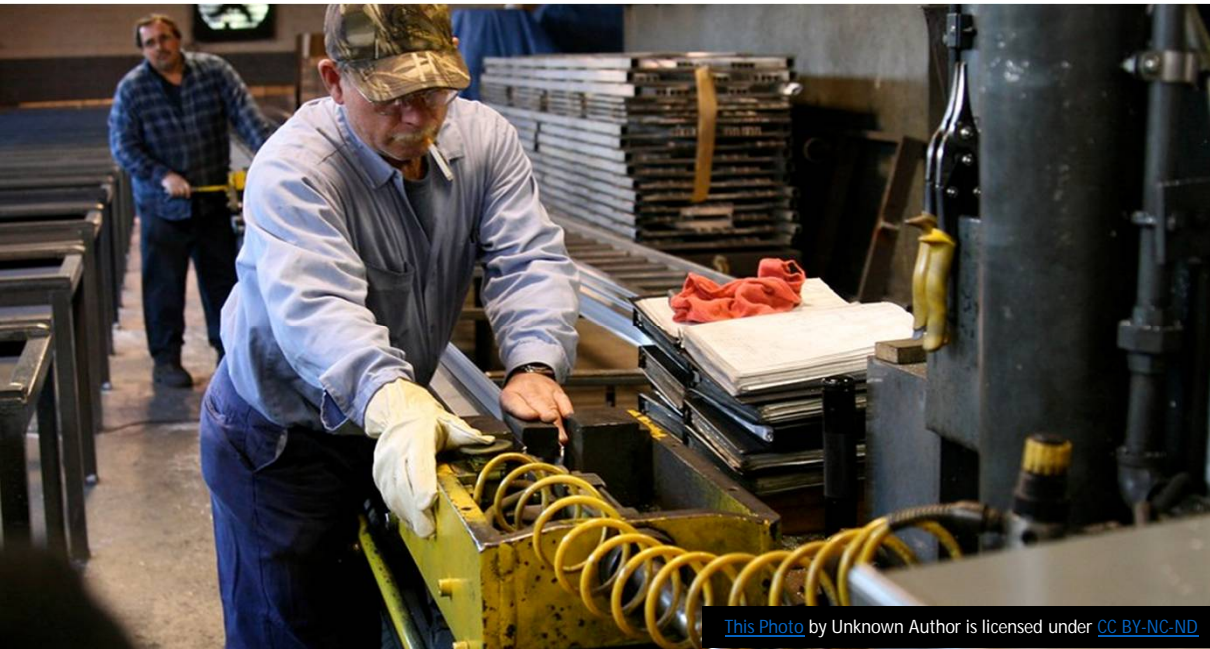
⁴Department of Animal Science, Kansas State University.



Degree of Feed Risk

HIGH High risk
MEDIUM Medium risk
LOW Low risk

The degree of feed risk is based on product type, manufacturing process, and ingredients. The risk level includes the assessment of manufacturers and suppliers with all FSMA requirements. Consider viral control to be controlled. The risk level is the highest and may be modified by the manufacturer's compliance.



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Examples of Preventative Controls

- **Ingredient Processing**
- Heating (pelleting, extrusion, expansion, toasting, conditioning, spray drying, rendering, steam flaking)
- Acidification
- Irradiation
- Cold plasma



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Examples of Preventative Controls

Supply Chain

Good Manufacturing Practices (cGMP)

Animal Food Safety Plan (HARPC)

Good Agricultural Practices (GAP)

Good Warehousing Practices (GWP)

Biosecurity Programs

Third-party Supplier Audits

Traceability and Recall Procedures

Laboratory Analysis of Ingredients and Complete Feeds

Examples of Preventative Controls

Sanitation

- Physical cleaning
- Removal of feedstuff residues and dust
- Employee hygiene
- Effective pest management



Examples of Preventative Controls

Sanitary Transportation





"dirty" and "clean" areas

eed delivery






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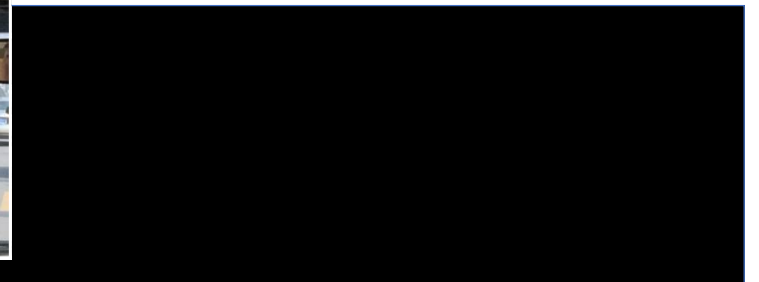
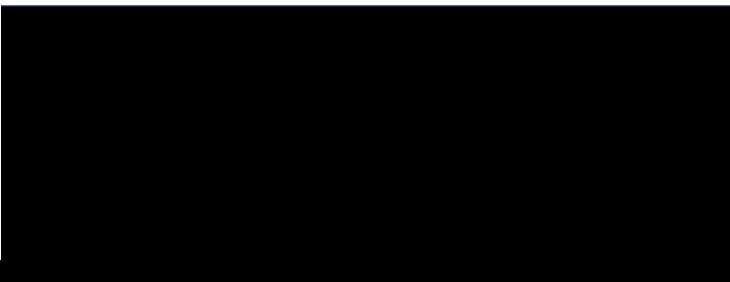
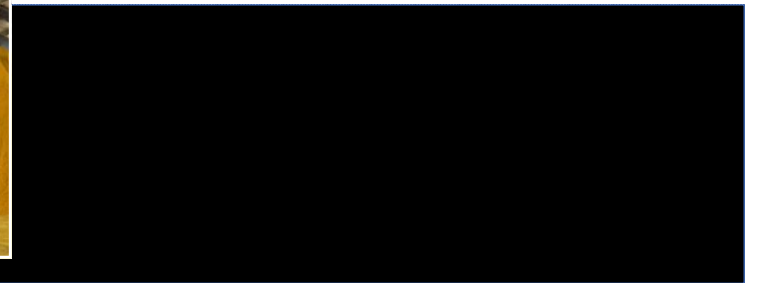
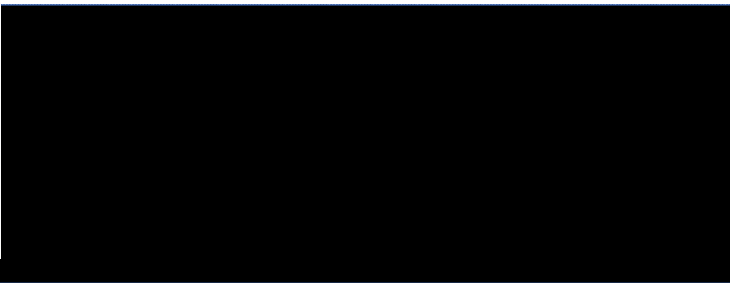
Validation AND verification are essential steps in food safety plans

| (1) Process Control | (2) Identify <u>potential</u> viruses and provide justification | (3) Validation | (4) Verification |
|------------------------|--|---|---|
| Rendering | <p><u>PEDV</u></p> <p>Ingredients can be contaminated with the virus</p>  | <p>Theoretical: Scientific study or technical report shows the <u>time-temperature combination</u> achieved in rendering can inactivate PEDV.</p> <p>In-plant: <u>90 days of processing records</u> showing time-temperature combination of the rendering equipment meets the values (critical limits) identified in the scientific study for viral inactivation.</p> | <p>Monitoring of time-temperature combination during rendering </p> <p>Calibration of thermocouples within the rendering equipment </p> <p>Monitoring of the moisture of the finished product </p> |

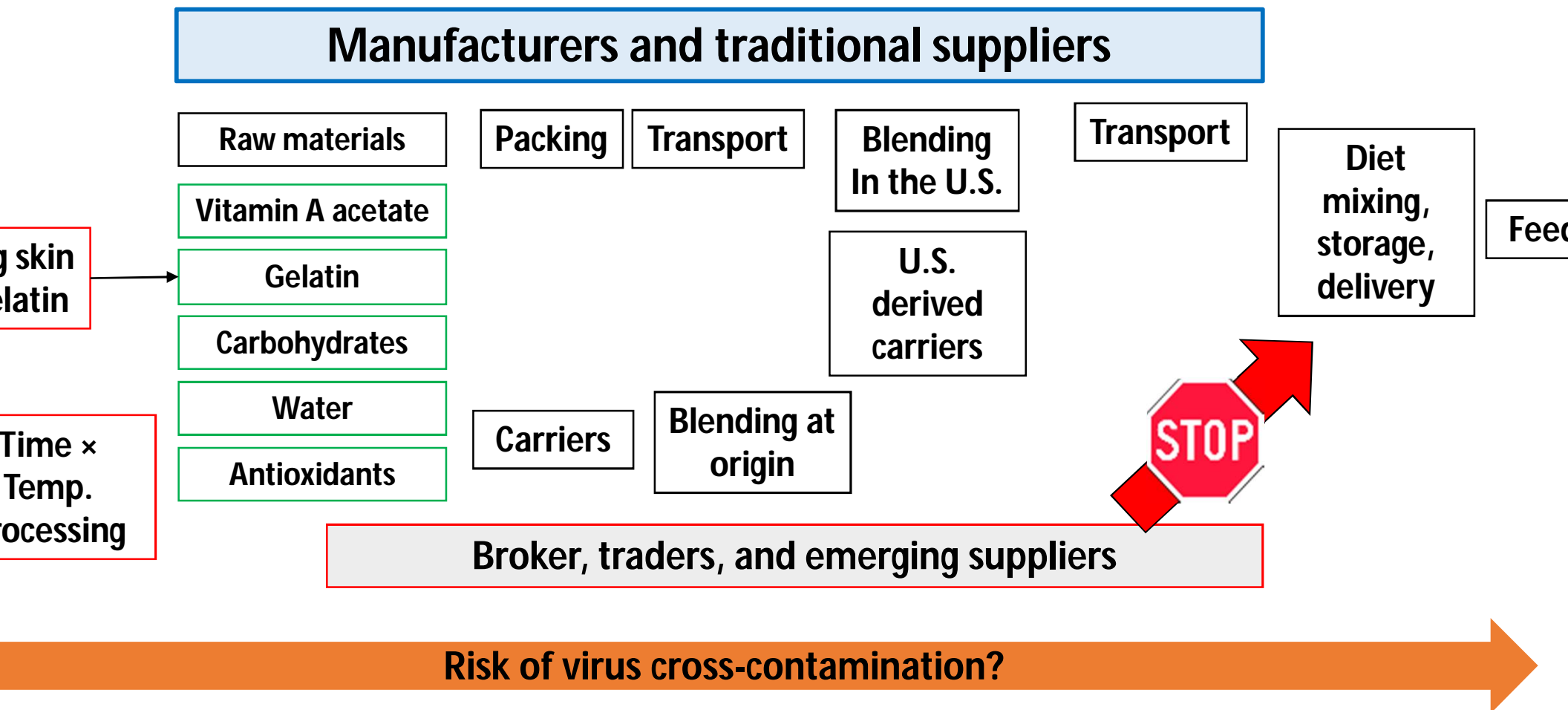
Example of supply chain preventive control plan

| 1) Material | (2) Supply Chain Control | (3) Who performs the preventive control? | (4) Verification frequency |
|--------------------------|---------------------------------|---|---|
| | GMP audit | Buyer or third-party certified auditor* | Initially before using the ingredient annually thereafter  |
| Beans or chicken meal | GAP audit | Buyer or third-party certified auditor* | Initially before using the ingredient annually thereafter  |
| | Testing for fecal contamination | Supplier | Sampling plan for generic <i>E. coli</i> (<u>survival</u> virus)  |

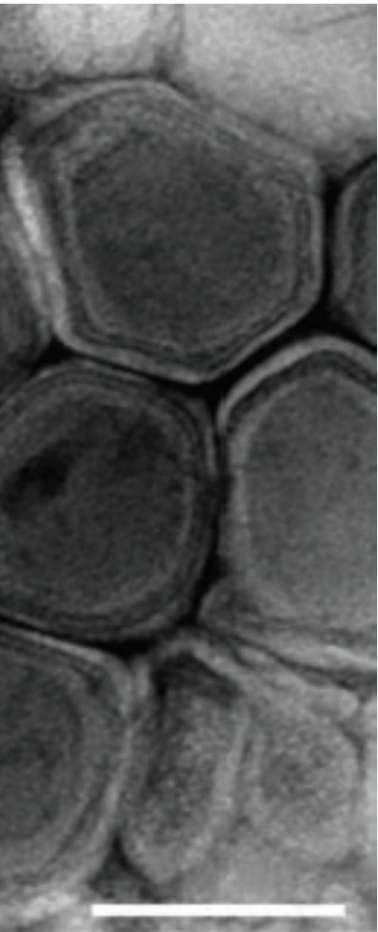
Example of transportation risk scenarios



Hypothetical flow chart of vitamin supply chain and associated risks for virus contamination



Emiliana huxleyi virus (EhV)

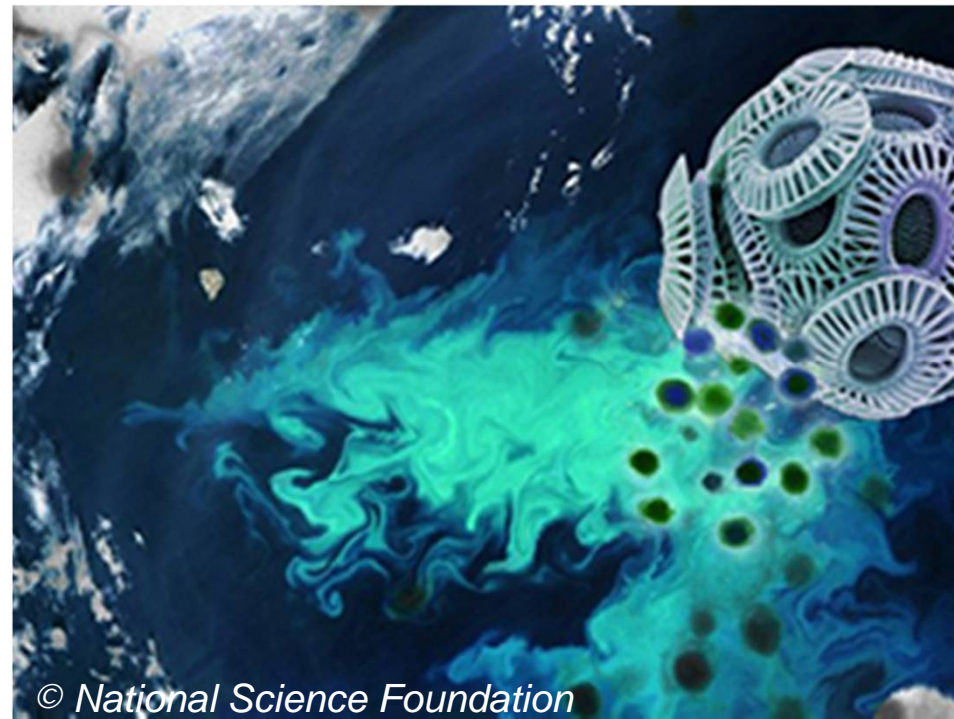


der, L.C., et al. 2009.

Emiliana huxleyi virus (EhV) is a double-stranded DNA virus and belongs to NCLDV (*Phycodnaviridae*).

Virus size: 170–190 nm in diameter.

Animal-like mechanism of infection: EhV enters its host via either an endocytotic or an envelope fusion mechanism. The new virus particle is released via a budding mechanism.

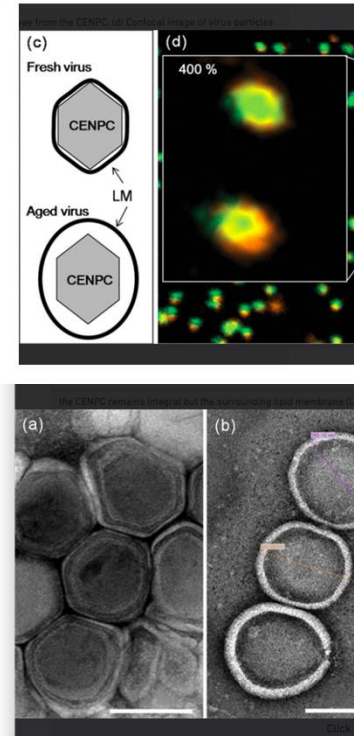
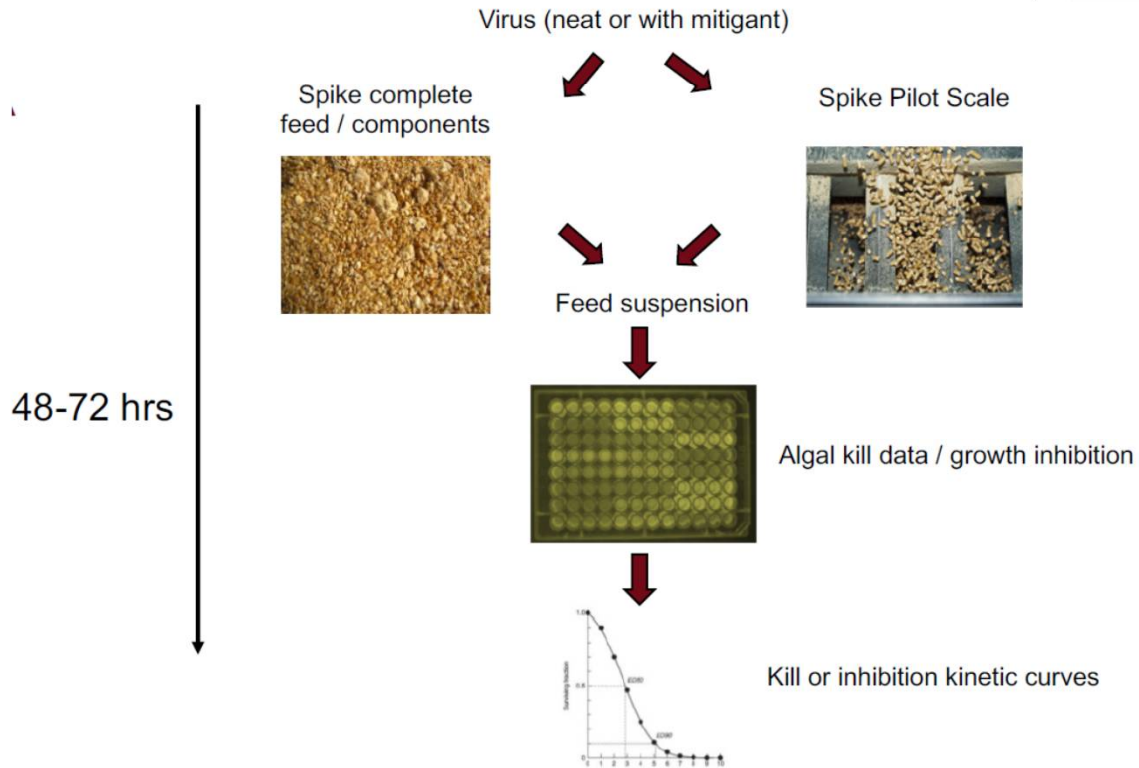
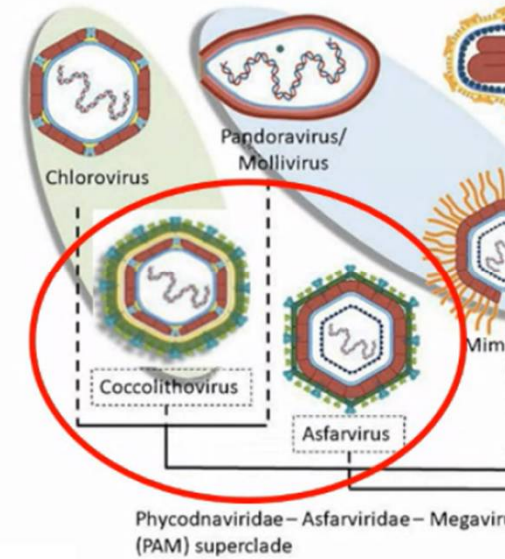
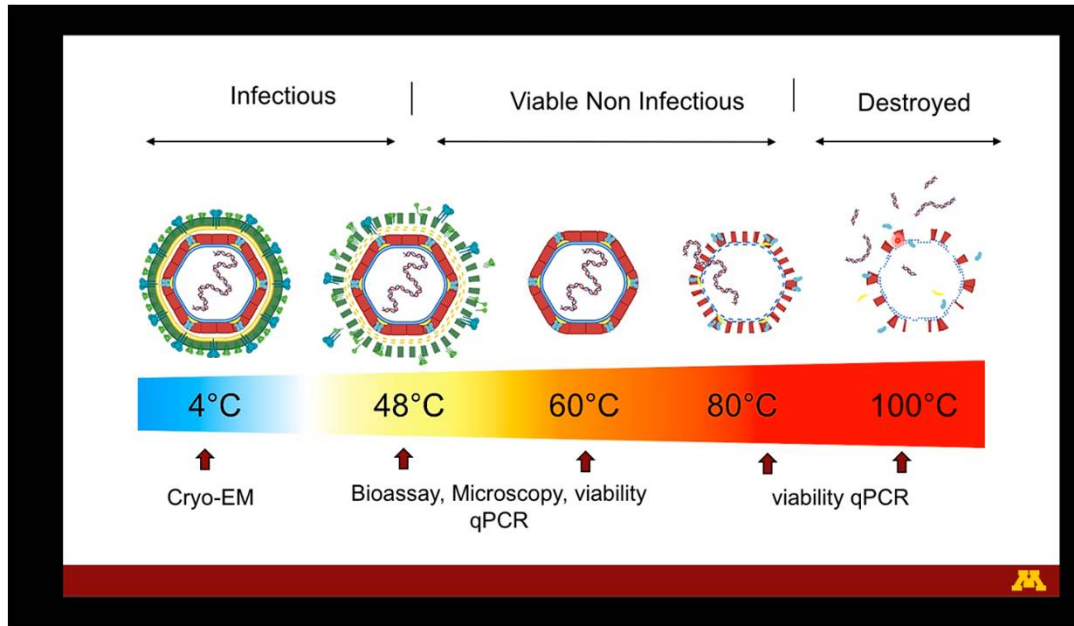


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Surrogate features (Busta et al 2003)

- ✓ Nonpathogenic
 - Similar inactivation characteristics and kinetics
 - Behavior similar to target microorganisms when exposed to raw ingredients
- ✓ Stable and consistent growth characteristics
 - Easily prepared to yield high-density populations
 - Once prepared, population is constant until utilized
- ✓ Easily enumerated using rapid, sensitive, inexpensive detection systems
 - Easily differentiated from other microflora (in our case pig viruses)
- ✓ Attachment characteristics that mimic those of target
 - Genetically stable
- ✓ Will not establish itself as a “spoilage” organism
- ✓ Susceptibility to injury similar to that of target pathogen

Risk-free *in situ* non-animal assay (RISNA)



Take home message

Feed is deemed safe:

- Hazard identification + mitigation
- Good manufacturing procedures

New knowledge of virus transmission

- Decision tree of risk factors
- Supplier verification
- Environmental sanitation
- Sanitary transportation





Acknowledgements

Geo

USDA

Il

National Pork Board

Swine Health Information Center

Oriental

Animal Nutrition Association of Canada

O' Lakes/Nutra Blend

National Grain and Feed Association

National Oilseed Processors Association

Plus

National Pork Producers Council

ns Grain

American Association of Swine Veterinarians

ue Farms

American Feed Industry Association

University of Minnesota

READYinc.



7TH PINOY PORK
CHALLENGE

SWINE INDUSTRY:
PADAYON...PATULOY...BUMANGON!

Thank you!



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