“African Swine Fever- Overview”

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African Swine Fever Virus

- Highly contagious viral disease of swine
- Asfarviridae
  - Enveloped DNA virus
  - Transmitted by arthropods
- Isolates vary in virulence
  - High virulence: up to 100% mortality
  - Low virulence: seroconversion

Source: Institute for Animal Health via commons.wikimedia.org
Epidemiology

Affects only

- Domesticated swine
- Wild boars

• Not a zoonotic disease
Transmission

• Direct contact
  – Usually oronasal
  – Infection after 1 to 9 dpe
Transmission

Indirect – responsible for most ASF outbreaks

- Uncooked garbage
- Contaminated people, vehicle, feed, water
- Bite of infected ticks
  - Ornithodoros erraticus
- Swine lice
- Biting flies
Transmission

Aerosol transmission is thought to be unimportant

Source: http://www.dvorak.org/blog/2009/05/01/dont-sneeze-on-our-pigs/
### Survival of ASFv in different conditions

<table>
<thead>
<tr>
<th>Conditions</th>
<th>ASFv survival time</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature of 50°C</td>
<td>3 hours</td>
<td>USDA, 1997</td>
</tr>
<tr>
<td>Temperature of 56°C</td>
<td>70 minutes</td>
<td>Mebus et al. 1998 in Foreign Animal Diseases</td>
</tr>
<tr>
<td>Temperature of 60°C</td>
<td>20 minutes</td>
<td>Mebus et al. 1998 in Foreign Animal Diseases</td>
</tr>
<tr>
<td>ph&lt;3.9 or ph&gt;11.5 (serum-free media)</td>
<td>Minutes</td>
<td>Mebus et al. 1998 in Foreign Animal Diseases</td>
</tr>
<tr>
<td>ph 13.4 in serum free media</td>
<td>21 hours</td>
<td><a href="http://www.oie.int/esp/maladies/fiches/e_A120.htm">http://www.oie.int/esp/maladies/fiches/e_A120.htm</a></td>
</tr>
<tr>
<td>ph 13.4 with 25% serum</td>
<td>7 days</td>
<td><a href="http://www.oie.int/esp/maladies/fiches/e_A120.htm">http://www.oie.int/esp/maladies/fiches/e_A120.htm</a></td>
</tr>
<tr>
<td>Blood stored at 4°C</td>
<td>18 months</td>
<td>Technical disease cards of Iowa State University,2006</td>
</tr>
<tr>
<td>Blood on wooden boars</td>
<td>70 days</td>
<td>USDA,1997</td>
</tr>
<tr>
<td>Putrefied blood</td>
<td>15 weeks</td>
<td>USDA,1997</td>
</tr>
<tr>
<td>Faeces held at room temperature</td>
<td>11 days</td>
<td>Technical disease cards of Iowa State University,2006</td>
</tr>
<tr>
<td>Contaminated pig pens</td>
<td>1 month</td>
<td>Technical disease cards of Iowa State University,2006</td>
</tr>
<tr>
<td>Slurry at 65°C</td>
<td>1 minute</td>
<td>C. Turner and S.M. Williams, 1997</td>
</tr>
</tbody>
</table>

Source: Jose M Sanchez- Vizcaino

*We are currently baking trailers at 160°F (71.1°C) for 10 minutes!!*
Survival of ASF in meat and meat products (Adkin et al. 2004)

<table>
<thead>
<tr>
<th>Product</th>
<th>ASFV survival time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>De-boned meat</td>
<td>105</td>
</tr>
<tr>
<td>Meat bone-in</td>
<td>105</td>
</tr>
<tr>
<td>Ground meat</td>
<td>105</td>
</tr>
<tr>
<td>Salted de-boned meat</td>
<td>182</td>
</tr>
<tr>
<td>Salted meat bone-in</td>
<td>182</td>
</tr>
<tr>
<td>Cook meat * (At least 30 min at 70°C)</td>
<td>0</td>
</tr>
<tr>
<td>Canned meat</td>
<td>0</td>
</tr>
<tr>
<td>Dried meat</td>
<td>300</td>
</tr>
<tr>
<td>Smoked de-boned meat</td>
<td>30</td>
</tr>
<tr>
<td>Frozen meat</td>
<td>1000</td>
</tr>
<tr>
<td>Chilled meat</td>
<td>110</td>
</tr>
<tr>
<td>Dried fat</td>
<td>300</td>
</tr>
<tr>
<td>Offals</td>
<td>105</td>
</tr>
<tr>
<td>Skin/fat</td>
<td>300</td>
</tr>
</tbody>
</table>

Source: Jose M Sanchez- Vizcaino
Virus viability in feed ingredient from complete feed.

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0194509
ASFv disinfection

Inactivated by:

• High temps:
  – 140°F for 30 min

• Disinfectants:
  – 2.3% chlorine for 30 min
  – Virkon
  – 1% NaOH or Ca(OH)₂ at 39°F for 3 min.
Clinical Signs- Acute Disease

• Incubation period: 4 to 19 days

• Clinical signs
  – High fever (104-108°F)
  – Moderate anorexia
  – Erythema, cyanosis
  – Recumbency
  – Bleeding from the nose
  – Bloody diarrhea
  – Abortion
  – Death

Clinical Signs - Chronic Disease

• Multi-focal erythema
  – Ears, abdomen
    • Raised or necrotic areas
• Intermittent, low fever
• Loss of weight
• Pneumonia
• Arthritis
• Death
Post Mortem Lesions

- Hemorrhagic
  - Spleen
    - Enlarged
    - Friable
    - Dark red, black
  - Lymph nodes
  - Kidneys
  - Heart
Differential Diagnosis

- Classical swine fever
- Acute PRRS
- Porcine dermatitis and nephropathy syndrome
- Erysipelas
- Salmonellosis
- Eperythrozoonosis
- Actinobacillosis
- Glasser’s disease
- Aujeszky’s disease (pseudorabies)
- Thrombocytopenic purpura
- Warfarin poisoning
- Heavy metal toxicity

Source: Center for Food Security and Public Health, Iowa State University, 2011
ASF vaccines approaches

- ASFV $\rightarrow$ immunomodulation $\rightarrow$ difficult to develop efficacious vaccine

- Killed vaccine do not confer protection

- Live-attenuated vaccines present difficulties due to safety and side effects in the vaccinated animals.

- Subunit and DNA vaccines - confer partial protection
Treatment

- No treatment or vaccine
ASF History 1957-2015

- Portugal: 1957, 60-99
- Spain: 1960-1995, 92 mln USD
- France: 1964, 1967, 1977, Genotype 1
- Italy: 1967, 69, 80, 93
- Russia: 1977
- Belgium: 1985
- Malta: 1978
- Netherlands: 1986, Genotype 1
- Sicilia: 1982-2015, Genotype 1
- Caucasus and Russia: 2007-2014
- Dominican Republic: 1978, 1981
- Haiti: 1979, 1984
- Cuba: 1971, 1980
- Brazil: 1978, 1981
- Angola: 1957
- Kenya: 1921
# ASF situation in Eastern Europe

<table>
<thead>
<tr>
<th>No. of outbreaks</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pigs</td>
<td>Wild boars</td>
<td>Pigs</td>
<td>Wild boars</td>
<td>Pigs</td>
<td>Wild boars</td>
</tr>
<tr>
<td>Poland</td>
<td>2</td>
<td>24</td>
<td>1</td>
<td>52</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Latvia</td>
<td>32</td>
<td>148</td>
<td>10</td>
<td>752</td>
<td>3</td>
<td>864</td>
</tr>
<tr>
<td>Lithuania</td>
<td>6</td>
<td>45</td>
<td>13</td>
<td>111</td>
<td>19</td>
<td>303</td>
</tr>
<tr>
<td>Estonia</td>
<td>0</td>
<td>41</td>
<td>18</td>
<td>723</td>
<td>6</td>
<td>1,052</td>
</tr>
<tr>
<td>Czech Rep.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Romania*</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hungary</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>258</strong></td>
<td><strong>42</strong></td>
<td><strong>1,638</strong></td>
<td><strong>48</strong></td>
<td><strong>2,299</strong></td>
</tr>
</tbody>
</table>

EU response to ASF

Regionalization of the affected countries:

• Part I region
• Part II region
• Part III region
Source of ASFV spread in EU

• Wild boars are the main source and vector for ASF in the EU
  – Wild boar population is growing rapidly
  – Positive ASF cases in wild boar population increased significantly in 2017 and 2018
ASF in Romania

• Domestic swine: 725 outbreaks; 13 counties affected
• 08/25/2018- Outbreak of the largest pig breeding farm- all 140,000 pigs will be culled
Poor Biosecurity measures
ASF outside the EU in 2018

Ukraine:
- Domestic swine: 42 outbreaks
- Wild boars: 30 cases

Russian Federation:
- Domestic swine: 8 outbreaks
- Wild boars: 37 cases

Moldova
- Domestic pigs: 3 outbreaks
- Wild boars: 0 cases

*Data is from Jan 2018 to June 2018
ASF in China

African Swine Fever outbreaks across China
Locations of the confirmed outbreaks of African Swine Fever across China as of August 24, 2018

Shenyang, Liaoning
First outbreak reported on small farm on Aug. 3

Jiamusi, Heilongjiang
Location of live market where pigs infected in second outbreak came from

Lianyungang, Jiangsu
Location of third case, 1,300 km from first case

Zhengzhou, Henan
Location of slaughterhouse where second infection discovered, 1,400 km from first case

Wenzhou, Zhejiang
Fourth outbreak found on three community farms, 2.150 km from location of first case

Source: Reuters, Maps4News
Number of Pigs Worldwide in 2018 in million head

Hog Density in China and Location of Three Cases of African Swine Fever (ASF)

Map Reproduced for Fair Use from Robinson et. al. Prepared by Steiner Consulting

- Zhengzhou #2 Case
- Shenyang #1 Case
- Shenyang #3 Case
- Jiamusi
  Hogs for #2 came from here

Map can be found at: https://livestock.geo-wiki.org/graphics/
Why is this important for US?

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy oil cake</td>
<td>15,126,647</td>
<td>7,977,560</td>
<td>13,545,880</td>
<td>24,201,390</td>
<td>36,962,316</td>
</tr>
<tr>
<td>DDGS</td>
<td>4,008,000</td>
<td>2,640,000</td>
<td>2,808,000</td>
<td>2,416,363</td>
<td>1,738,182</td>
</tr>
<tr>
<td>Pet food</td>
<td>4,075,353</td>
<td>3,068,722</td>
<td>623,734</td>
<td>51,587</td>
<td>1,412,165</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>1,832,561</td>
<td>1,816,100</td>
<td>1,340,270</td>
<td>979,627</td>
<td>185,400</td>
</tr>
<tr>
<td>Pork sausage casings</td>
<td>129,365</td>
<td>216,845</td>
<td>457,427</td>
<td>420,005</td>
<td>582,093</td>
</tr>
<tr>
<td>Lysine</td>
<td>33,000</td>
<td>95,000</td>
<td>19,764</td>
<td>2,325,236</td>
<td>2,393,915</td>
</tr>
<tr>
<td>Choline</td>
<td>19,000</td>
<td>400</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>26,000</td>
<td>21,000</td>
<td>14,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL (KG)</strong></td>
<td>25,249,926</td>
<td>7,198,012</td>
<td>18,809,075</td>
<td>30,394,208</td>
<td>43,274,071</td>
</tr>
</tbody>
</table>

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0194509
• Control in domestic pigs with good biosecurity is very efficacious

• Food ingredient mitigation strategies

• *Ornithodoros erraticus* tick is not native the US

• Aerosol transmission unimportant

• Baking trailers at 160°F for 10 minutes
• Problems occur when the virus establishes in the feral pig population

• Population of feral pigs is increasing in urban areas
  – Increased risk!!
**Big risks:**

- Transport
- Truck washes
- Feed