African Swine Fever Research and Current Situation

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African Swine Fever Virus

- Sole member of Asfarviridae
- Large Icosahedral DNA virus
- Large dsDNA genome: 170-190 kbp
- Replicates in cell cytoplasm
- Infects and persists in soft ticks and members of Suidae family
African Swine Fever

- Virulence ranges from high to low
- Affects domestic and wild pigs
  - Produces inapparent infection in two species of wild African swine
    - Wart hog
    - Bush pig
- High mortality in domestic pigs
Suidae family
African Swine Fever Virus
Natural Cycle

Enzootic Cycle (sylvatic)

Epidemic Cycle (peridomestic)

Transstadial transmission
Transovarial transmission
Venereal transmission
Vector-borne transmission

Ornithodoros porcinus

warthog
eggs & N1
N2
N3
N4
N5

domestic pigs
Pig to pig transmission
African Swine Fever Virus

- Stable in the environment
  - Resistant to wide pH range (3.9 - 11.5)
  - It can survive for a year and a half in blood stored at 4º C, and at least a month in contaminated pig pens
  - Remains infectious for 150 days in boned meat stored at 39º F, 140 days in salted dried hams, and several years in frozen meat
ASF: The Disease

- Highly lethal (100%) to subclinical
- Edema, ascites and hemorrhage
- Virulence associated with replication and spread within the mononuclear-phagocytic system
- Long-term persistent/latent infection
- All domestic pigs susceptible
- Large natural reservoir in nature
- No vaccine available
Clinical Signs: Acute Form, High Virulence

- Incubation period: 48-72 hours
- High fever (animals huddled)
- Moderate anorexia
- Leukopenia, thrombocytopenia
- Recumbency
- Erythema, cyanotic skin blotching
- Possibly diarrhea (bloody) and abortions
- Vomiting
- Ocular discharge
- Death can follow (100% mortality in domestic pigs)
- Survivors are virus carriers for life
Clinical Signs: Acute Form, High Virulence
Clinical Signs:
Subacute Form, Moderate Virulence

- Less intense symptoms
- Duration of illness is 5-30 days
- Abortion in pregnant sows
- Death within 15-45 days
- Mortality rate is lower (e.g. 30-70%)
Clinical Signs: Chronic Infection

- Multi-focal erythema
  - Ears, abdomen, inner thigh
  - May be raised and necrotic
  - Develops over 2-15 months
- Pericarditis
- Low fever
- Pneumonia
- Painless swelling of carpal and tarsal joints
- Emaciation, stunting
- Death (low mortality)
Geographic Distribution

- Until 1957: Endemic in sub-Saharan Africa (Equator to northern South Africa)
- After 1957: Found in wild boar and feral pigs Sardinia, Portugal, Spain
- 1970’s spread to Cuba, Haiti, the Dominican Republic, Brazil
- Spread in Europe 1980’s
- Eradicated in most of Europe 1990s
ASF Distribution 1990-2006

ASF restricted to Africa and Is. Sardinia
2007 ASF outbreak in the Caucasus

Emergence in R. of Georgia
Beginning of 2007 in R. of Georgia and has since spread to the neighboring countries of Armenia, Azerbaijan and Russia
ARS Mission

ARS conducts research to develop and transfer solutions to agricultural problems of high national priority.
ASF RESEARCH GAPS

- **Pathogenesis:** viral and host virulence determinants – early events in infection
- **Virus ecology:** host tick - virus interactions – role in transmission
- **Immunology:** protective immune response: there are no effective vaccines!
- **Epidemiology:** transmission cycles – direct vs vector
ARS Research Program – until 2004

• Protective Immunity to ASF

• Viral Functional Genomics
  • Virulence/host range genes
  • Host susceptibility and/or resistance genes

• Comparative genomics
ARS Research Accomplishments

• First to determine the genetic content of pathogenic ASF viruses
• First to develop techniques for genetically engineering ASFV genome
• Identified and characterized novel ASFV virulence/host range genes
• First to genetically engineer live-attenuated ASF viruses which protect swine from ASF
• Characterized persistent ASFV infection in tick host
• Described latent infection as sequel to infection in all surviving pigs (carrier animals)
• Defined protective host responses to virus infection
• First to identify viral antigens involved in protective immunity
ASFV genome – 190 kbp

- Structural proteins: p30, p72, p54
- Immune response modulation: 5EL (IκB), 8CR (lectin), 8DR (CD2)
- Prevention of apoptotic cell death: 5HL (Bcl2), 4CL (iap)

Host range and virulence associated genes

- NL, UK, 9GL, TK
- Multigene family (MGF) 360 genes
- Multigene family (MGF) 530 genes
Genetic engineering of ASFV

- ASFV
- PCR
  - Amplify left flank
  - Amplify right flank
- INSERT REPORTER GENE
- Transfer Vector (TV)
- INFECTION
  - ASFV
  - TRANSFECTION
- TV
- RECOMBINATION
  - Macrophages
ARS Current Research

- Countermeasures to Control Foreign Animal Diseases of Swine – Dr. Manuel Borca P.I.
  - Develop intervention strategies to control ASFV
    - Identify virus-host determinants of virulence and transmission
    - Develop technologies to enable the development of ASF vaccines that are efficacious against the most prevalent ASF strains
FADRU Staff

- 6 Administrative staff
- 8 Senior scientists
- 5 Visiting Scientists
- 10 support scientists
- 5 ARS postdocs
- 15 PIADC-ORISE Research Fellows
- 10 University Cooperators
- 2 Federal Collaborators

TOTAL ARS PERSONNEL AT PIADC 60
Thank you!