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African swine fever: A set back to growing pig industry and socioecomic marginal farmer of India

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ABSTRACT

African swine fever is a highly contagious, fatal, and transboundary viral disease of domestic and wild pigs. This disease is caused by the *African swine fever virus.* It causes 100% morbidity and mortality. African swine fever causes heavy economical loss to the pig industry of the affected country. Any region of world having pig population is prone to African swine fever. *African swine fever virus* is highly stable to environmental conditions that attribute to the spread of this disease to a long distance from its origin. There is no treatment and vaccine available for African swine fever, only strict preventive and control measures can be used to save the pigs from African swine fever. In this article, different aspects of African swine fever are discussed in detail including a recent outbreak of African swine fever in India.

Keywords: African swine fever, ASFV, mononuclear phagocyte system, *Ornithodoros moubata*

INTRODUCTION

Pig farming is a viable and profitable enterprise. The initial investment to start a pig farm is low as compared to other livestock farming. They are highly prolific (with an average litter size of 10 piglets) and have efficient food conversion capability. Pork consumption is highest in the world compared with the meat of other animals. Pig farming can contribute to uplift the economic status of poor people and small-scale farmers. Pork provides high-value animal protein, so it can play an important role to meet the protein requirement of malnourished poor people. Besides, favorable conditions for pigs farming a decline in the growth of the pig industry are observed

worldwide. In India, the distribution of the pig population is not uniform geographically. There may be different reasons for this decline, but the main culprit may be the re-emerging infectious diseases of pigs. Among them, African swine fever is a highly contagious, deadly, and economically important disease of pigs. As per the 20th livestock census, a decline of 12.03% was observed in the pig population over the previous livestock census. According to the 20th Livestock census, Assam ranked first in pig population followed by Jharkhand. There may be different factors like exotic and re-emerging pig diseases, lack of pig farming at the commercial level, lack of marketing availability for pork and pork products, lack of Government policies, etc. for this decline. African swine fever (ASF) is a transboundary, highly contagious, and fatal disease of pigs. ASF originated from Africa in the 1920s (Costard *et al*., 2009). Its etiological agent is a double-stranded DNA virus, *African swine fever virus* (ASFV), which is characterized by high morbidity and mortality rate in domestic and wild pigs of both sexes of all age groups. ASF has severe economic consequences associated with production losses, trade limitations, and eradication programs (Costard *et al*., 2009). ASF is a notifiable disease to the World Organization for Animal Health (OIE). So far, the disease has reached in more than 50 countries (Fenollar and Mediannikov, 2018). The spreading of virus from endemic area to virus-free area is facilitated by both legal and illegal movements of live animals, as well as the importation of animal products, byproducts, and animal feed (Brown and Bevins, 2018). Recently, ASF has been reported in the Northeastern region of India during early 2020. In this article, different aspects of African swine fever are discussed in detail including a recent outbreak of African swine fever in India.

Epidemiology

ASF was described for the first time from Kenya in 1921. In 1957, ASF was described from Portugal, it was the first time ASF was reported from outside Africa. From Portugal, ASF spread rapidly to other European countries including France, Italy, Malta, Belgium, and the Netherlands. In 2007, major outbreaks occurred in Georgia, Armenia, Azerbaijan, and the European part of Russia, Ukraine, and Belarus. So far pigs from more than 50 countries around the globe are affected with ASF. In Asia, China was the first county to report the ASF outbreak in August 2018 followed by Mongolia (January 2019), Vietnam (Februray 2019), Cambodia (March 2019), North Korea (May 2019), HonKong (May 2019) and Mayanmar (September 2019). Recently in early 2020, India has reported for the first time the outbreak of ASF in the Northeastern region adjoining to China. The representative specimens from dead pigs of Assam and Arunachal Pradesh are tested in the National Institute of High-Security Animal Diseases (NIHSAD), Bhopal, India and confirmed for the presence of ASFV. The ASFV persists in nature under different cycles that include the sylvatic cycle, the tick-pig cycle, and the domestic (pig-pig) cycle. Recently, a wild boar cycle has also been described (Olesen *et al*., 2020). Warthogs are considered as a reservoir of ASFV and participate in the sylvatic cycle with ticks of the *Ornithodoros moubata* complex (Jori*et al*., 2013). ASFV persists in the lymph nodes. ASFV spread from warthogs to domestic pigs either via direct contact with warthogs or indirect contact with fomites, vector, and feeding contaminated pork

products to the domestic pigs. Mechanical transmission via *Stomoxys calcitrans* has been reported within 48 hr of a blood meal on an infected pig (Olesen*et al*., 2020).

African swine fever virus

African swine fever virus(ASFV) belongs to the genus *Asfivirus* and family *Asfaviridae*. ASFV contains a single molecule of dsDNA as a genome. Its genome length is 170-190 kbp. ASFV has icosahedral symmetry and the capsid consists of 1892 or 2172 capsomeres. The capsid is surrounded by a lipoprotein membrane. Twenty-three genotypes have been described based on the partial sequences of the p^{72} gene (Brownand Bevins, 2018). All 23 genotypes are prevalent in Africa. But, only genotypes I and II have been found outside of the Africa continent. The mononuclear phagocytic cells are the primary target cells of ASFV. ASFV is a very stable virus and can survive for a longer period under different environmental conditions. The virus can sustain in different raw and processed pork products including chilled, fried, smoked, offals, blood, skin, etc. ranging from 11 days to 1000 days (FAO, 2013).

Pathogenesis

There are two scenarios;in the first scenario ticks are involved in disease production and second scenario ticks are not involved in disease production. In the first scenario, ASFV gains entry into the host through tick biting. In the second scenario, ASFV gains entry into the body through the tonsils or dorsal pharyngeal mucosa to the mandibular or retropharyngeal lymph nodes.From there, the virus spread to other sites and produce viremia. ASFV is detectable from all the tissues of the body. But, ASFV is found at higher titer in the mononuclear phagocyte system (spleen and lymphnodes).The infection of dendritic cells is observed which may interfere with humoral immune responses. ASFV activates the secretory and phagocytic activity of macrophages. These activated macrophages secrete proinflammatory cytokines such as IL-1, IL-6, and TNF-α. This induces fever and vascular changes like vasodilatation and increased permeability. These pro-inflammatory cytokines also cause interstitial edema and fibrin microthrombi formation in septal capillaries (Bloome et al., 2013).

Clinical disease

The incubation period of ASF varies from 4-19 days. Clinical disease occurs in four forms; peracute, acute, subacute, and chronic (Yoo*et al*., 2020). These are described below-

a. **Peracute form**-
   In peracute form affected animals die without any visible clinical symptoms with mortality rate upto 100% (Gallardo *et al*., 2017).

b. Acute form-
   An acute form of the disease caused by highly virulent strains and are typically characterized by a high fever, anorexia, lethargy, weakness, recumbency, diarrhea and/or constipation, abdominal pain, hemorrhagic signs, respiratory distress, nasal and conjunctival discharge, and abortions in pregnant females. Death often occurs within 7–10 days after the onset of clinical signs.

c. Sub-acute form-

Moderately virulent strains result in subacute infection (often with high mortality in young animals and much lower mortality in older animals), where the clinical signs often include abortion, fever, and transient hemorrhaging with death or recovery occurring within 3–4 weeks (Sargsyan*et al*., 2018).

d. Chronic form-

Chronic infections are characterized by intermittent or low fever, loss of appetite, depression, and in some instances result in a fatal infection (Sargsyan*et al*., 2018).

Infected domestic pigs may start shedding viruses before the appearance of African swine fever. The recovered pigs may shed infectious virus for 1 month after the disappearance of clinical signs (FAO, 2013).

Diagnosis

Following techniques can be used for the diagnosis of ASF-

- ASFV can be isolated from the live pig (Nasal swab, blood, bioptic tissue from lymph nodes) or postmortem tissue (spleen, kidney, tonsils, and lymph nodes) of a dead animal. Pig leukocyte cells, bone marrow cultures, porcine alveolar macrophages, and porcine blood monocytes can all be used in ASFV culture (0IE, 2019).
- For detection of ASFV antigens conventional PCR, real-time PCR, direct fluorescent antibody test, and antigen ELISA tests can be used (FAO, 2013).
- For the detection ofthe ASF antibodyELISA test, an indirect fluorescent antibody (IFA) test, by indirect immunoperoxidase test (IPT) can be used (Laddomada*et al*., 2019).

At field level due to lack of infrastructure, equipment, reagents, and/ or unnecessary delay in reaching the sample to the laboratory may delay the diagnosis process. These limitations can be overcome by pen-side tests. Pen-side helps in initial screening of disease at spot tests before laboratory test reports came There is two pen-side tests are commercially available by INGENASA for ASF; one pen-side for detection of antibodies against using lateral flow device (LFD) and second pen-side for detection of ASFV antigen using lateral flow device (LFD) in the blood. (Sastre*et al*., 2016; Cappai*et al*., 2017).

Postmortem lesions

There are no pathognomonic lesions of ASF. The postmortem (PM) lesions of ASF are difficult to differentiate from postmortem lesions of classical swine fever (CSF) or hog cholera. There is bluish-purplish discoloration of the skin of extremities, chest, and abdomen. In peracute ASF, only erythema is present. In acute ASF, there is erythema, hyperaemic splenomegaly, petechial hemorrhage on the kidney (mainly in the cortex) and gallbladder, severe alveolar edema, hemorrhage in epicardium and endocardium. In subacute ASF, PM lesions are similar to acute ASF except forhydropericardium, petechial hemorrhages in cortex, medulla and pelvis, perirenal edema, abortion, and the

majority of lymph nodes resemble a blood clot. In chronic ASF, erythema is replaced by necrotic areas, spleen enlarged and normal in color, abortion, and fibrinous pericarditis. The pleuritis and pneumonia are also common in chronic form. Other common observation includes swollen joints and generalized lymphadenopathy. The lining of the stomach has hemorrhages and sometimes ulcers are also present. Gastrointestinal tract (GIT) may be congested and the contents of GIT may contain blood (Sánchez-Vizcaíno et al., 2015).

Differential diagnosis-

ASF should be differentiated from other similar looking diseases that include-
- Classical swine fever (CSF)
- Porcine reproductive and respiratory syndrome (PRRS)
- Porcine dermatitis and nephropathy syndrome (PDNS)
- Erysipelas
- Aujeszky's disease
- Salmonellosis
- Septicaemias
- Poisoning

Prevention and control

There is no specific treatment and vaccine available against ASF. The following preventive and control measures can be adopted to control the ASF-

- Slaughter and proper carcass disposal of infected as well as suspected pigs.
- ASF is a vector-borne disease, so the elimination of its vector is an important step in controlling the disease.
- Restrict movements of live pigs, their products from an infected area to non-infected area.
- Strict biosecurity measures should be adopted in commercial as well as backyard farms.
- Fomites (clothes, utensils, vehicles, shoes, etc.) are also an important source of ASF. So, there should proper arrangements for the disinfection of fomites.
- Fences must be installed to block intruders such as roaming wild boar.
- Avoid Swill feeding.
- There should be strict regulations and controls on food waste from international flights, and ships.

Things to be done during an outbreak

The farms which are infected must be placed in complete isolation and farms which are suspected/ at riskto be infected must be quarantined. The movement of live pigs, raw pork, and processed pork products should be prohibited from infected areas to non-infected areas. All the infected pigs should be slaughtered and carcasses must be either burnt or buried deeply as per standard operating procedure (SOP). Strict biosecurity measures should be followed like all vehicles should be disinfected on entering and

leaving farms and personnel should ensure that shoes, clothes, and equipment are disinfected between farms.

CONCLUSION

African swine fever (ASF) is a highly contagious and deadly disease affecting domestic and wild pigs. ASF is considered one of the most serious threats to the pig industry worldwide. Recently in early 2020, the outbreak of ASF has been reported from Northeast India. It may pose a serious threat to the entire pig husbandry due to high morbidity and mortality rate. As mentioned above, there is no specific treatment or protective vaccines are available against the disease, so the Government of India must take properprecautions and preventive measures to control the ASF and protect the poor and marginal pig farmers of India.

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