

## Mysteries in Transmission of Porcine Epidemic Diarrhea

### What is Porcine epidemic diarrhea (PED)?

Porcine epidemic diarrhea (PED) is a viral infection caused by oral infection with PED virus with watery diarrhea and anorexia as main symptoms. PED virus belongs to the Coronaviridae family. The coronavirus that has been frequently isolated from pigs with TGE, patients with MERS, which was once prevalent in South Korea, and the lungs of cattle also belongs to the same family. The electron micrographs of the viral particles show an image reminiscent of the solar corona, from which the name of the virus is believed to be derived. At present, coronavirus may launch a counterattack against the human world and the animal kingdom.

### Epidemiology of PED

The virus genotype prevalent in China in 2010 was found in USA in May 2013 (for the first time in USA) and has now been prevalent. It subsided for a while, but it seems to increase recently. In Japan, the same genotype was found in Okinawa in September and in Ibaraki in November 2013 and then, the infection expanded in southern Kyushu mainly in January as well as in Kanto and Tokai districts mainly in April 2014. Since then, the infection has continuously occurred in various regions.

The reasons why PED attracts attention so much in pig farming industry are the magnitude of the damage and many mysteries in the route of transmission. Especially, damages in farrowing houses are serious. Many more American researchers than Japanese ones have made a strong effort to elucidate the mysteries but there are still some left in its epidemiology. In Japan, many mysteries have arisen. Why PED occurred in such a farm with enhanced biosecurity? Why PED occurred in such an isolated farm without any farms in the surrounding area? Why PED does not occur in such a farm where many various types of diseases occur and biosecurity is neglected? Therefore, the possibility of the contamination of plasma protein has also been brought into view.

Here, among these mysteries, we discuss two points that seem to be most relevant to transmission of PED. PED does not tend to occur in the farm where the first point is complied with. As for the second point, it is meaningful that the invasion of PED to farrowing houses can be prevented even when the infection occurs.

### **1. Shipment of hogs by shipping tracks**

It is not an exaggeration to say that a shipping track is the most significant contamination source of this infection. There is a possibility that a track is contaminated because hogs are carried from many farms into slaughterhouses. In addition, shipping tracks are one of the most difficult thing to disinfect.

A lot of earth and sand is cumulated in a tire house and on the muffler and chassis below. A lot of viruses may lurk in this earth and sand. In a loading platform, viruses easily remain in the gates and the hinge area of the door where dust easily accumulates and it is difficult to clean there. As there is also a possibility that the driver's seat is contaminated, disinfection of the seat is necessary. It is very important to make track drivers understand the necessity of epidemic prevention and it is also very important to establish the communication between farms and drivers.

It is said that there is a high possibility that many pathogenic microorganisms such as PRRS virus and swine erysipelas bacterium are brought in from slaughterhouses. Damages due to swine erysipelas have been comparatively less in Kyushu but the epidemic has been observed in the past years and shipping tracks are considered to be one of the causes.

It is a good way to enhance the epidemic prevention by establishing the place for hog transshipment outside the farm, carrying the hogs there by farms and transshipping them to a shipping track bound for a slaughterhouse, if possible. A driver of a shipping track should not get out of the shipping track bound for a slaughterhouse. After completion of transshipment, the shipment platform and the farm track used for shipment should be cleaned and disinfected. The footwear and work clothes should be changed at a minimum.

Do not allow vehicles of pig slaughterhouse workers to enter the farm. Carry the slaughtered pigs to the outside of the farm and pass them to the slaughterhouse workers. Then, use the same procedure as those used for shipment of hogs. There is a big possibility that the vehicles of the slaughterhouse workers may be a contaminant source.

## 2. Movement of workers in a farm

Although it is important to pay attention to entry of people from the outside, the movement of workers within the farm is also very important. In reality, it is very hard to do this and that. Therefore, we will show the effective method which can be implemented starting tomorrow, that is footwear: boots for inside the pig houses, boots for moving around a farm and footwear for outside a farm. It is easy to distinguish the boots for inside the pig houses by changing the color of the boots by pig house. A duckboard or the like should be placed in-between area where the boots for inside the pig houses are changed for those for moving around the farm, in order to bear in mind the necessity of changing the footwear there. Animal droppings are stuck on surface of the rubber bottom of the boots for inside the pig houses, and as it takes a lot of time to clean them completely, it is faster to change the footwear.

As a matter of course, in a pig farm with certain scale, the persons in charge of farrowing house, piglet house, and fattening piggery should be separate. When the persons in charge of a piglet house or a fattening piggery have to enter a farrowing house, not only footwear but also working clothes should be changed. If it is impossible to change the clothes, only putting a paper coverall over the working clothes will make a big difference. By implementing these things, movement of pathogens between pig houses can be prevented.

### **Mechanism of Action of PED vaccine**

PED is an infectious disease with a high mortality rate which causes serious diarrhea and dehydration in suckling piglets. Though PED vaccines are used for prevention of onset or alleviation of the symptoms in suckling piglets, the vaccines are inoculated not to suckling piglets but to mother sows. The sows vaccinated secrete a neutralizing antibody against PED virus not only in the colostrum just after delivery but in normal milk. When piglets continue to suckle the milk containing this neutralizing antibody, the neutralizing antibody will cover the intestinal mucosal surface of the suckling piglets. Therefore, when PED invades into the intestine of the suckling piglets, the virus is neutralized and infection is suppressed (Figures 1, 2).

This is called lactogenic immunity and its mechanism of action is completely different from that of so-called maternal immunity, that is, mother-child immunization via colostrum (maternal antibody derived from colostrum of mother's milk is released into the blood of piglets: mainly taken into the body of piglets within six hours after birth). The maternal antibody derived from colostrum in the blood of piglets is nearly ineffective for prevention of infection at the intestinal mucosa (local infection) because the antibody is not secreted into the intestinal tract of the piglets. Therefore, in order to exert the effect of PED vaccine sufficiently, it is necessary for suckling piglets to continue to suckle milk from mother immunized with vaccine.

### **Immunization program of PED vaccine**

Figure 3 shows the immunization program of PED vaccines marketed by Nisseiken to pregnant sows. Both vaccines are administered to mother sows twice during gestation. It is indicated in the direction for use that the second inoculation is performed about two weeks before the estimated date of delivery, however, for Nisseiken PED live vaccine, the inoculation interval between the first and the second inoculation is two to eight weeks, while four to eight weeks for Nisseiken TGE-PED live combination vaccine. The indication of both vaccines is not protection of immunized mother sows against infection with the virus but prevention of onset or alleviation of symptoms of PED in suckling piglets. The vaccines exert their effects when the neutralizing antibody released in the milk of immunized mother sows is ingested by suckling piglets with milk.

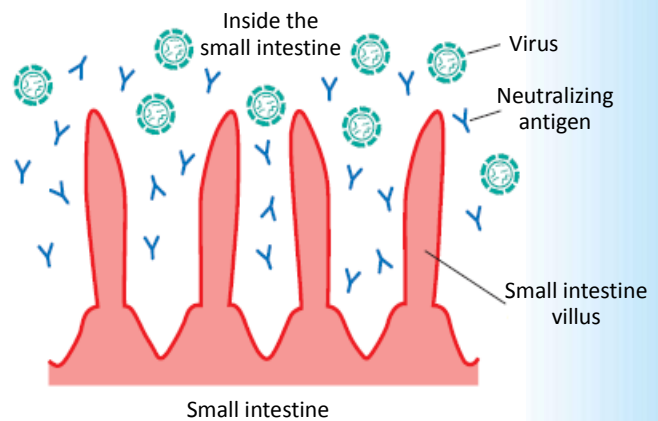
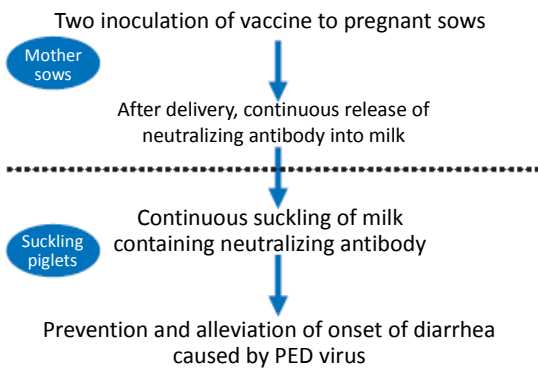
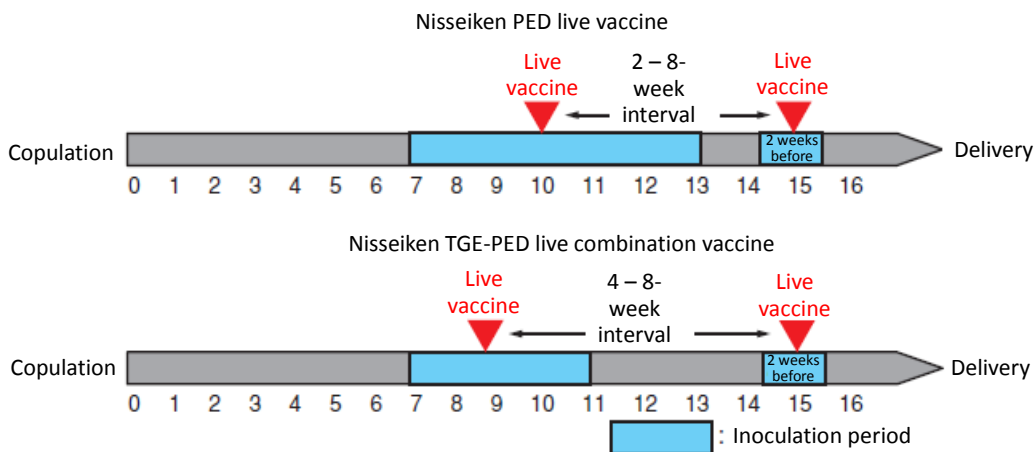


Figure 1. Mechanism of lactogenic immunity of PED vaccine

Figure 2. Neutralization of virus by protective antigen derived from milk



The number 0 to 16 indicates the gestational week of pregnant sows

Figure 3. Immunization program of Nisseiken PED vaccines to pregnant sows