# Seroprevalence of serotype O of foot-and-mouth disease virus in vaccinated pigs and cattle in Ho Chi Minh City

**Mai C. Duong[1*], Vy T. Tran[1], Long N. T. Duong[1], Phuong P. B. Nguyen[2], Thanh D. H. Le[2], & Hien T. Le[1]**

[1]Faculty of Animal Science and Veterinary Medicine, Nong Lam University, Ho Chi Minh City, Vietnam
[2]Division of Sub-department of Animal Health, Ho Chi Minh City, Vietnam

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[*]**Corresponding author**

Duong Chi Mai
Email: mai.duongchi@hcmuaf.edu.vn

**ABSTRACT**

The aim of this study was to assess the seroprevalence against serotype O FMD (foot and mouth disease) virus in vaccinated pigs and cattle in Ho Chi Minh City, as a basis to serve the prevention of FMD epidemics in these animals. A total of 535 pigs and 366 cattle sera were tested by using the Elisa kit for the detection of serotype O FMD antibody (Pirbright, UK). Results of this study showed that most pig farms had the proportions of positive animals for antibodies against FMDV serotype O which met the requirements of Decision no. 07/2016/ Ministry of Agriculture and Rural Development, except Xuan Thoi Thuong, Thai My and Phu My Hung. All sows had high levels of antibodies against serotype O FMD virus. There were no significant differences in the ratios of positive pigs for antibodies against FMDV serotype O among types of pig and age groups. However, there were significant differences in the seroprevalence of vaccinated pigs across herd sizes and days post-vaccination. Meanwhile, the overall seroprevalence of vaccinated cattle against FMDV at individual-level was over 80.00%. No statistical differences were found in the seroprevalence of vaccinated cattle against type O FMDV among regions, types of cattle, herd sizes, age groups and days post-vaccination. In conclusion, pigs raised in farms of Xuan Thoi Thuong, Thai My and Phu My Hung communes should be revaccinated with FMD vaccine to prevent the risk of pigs being infected with FMD virus and reduce the amount of virus produced by an infected animal.

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## 1. Introduction

Foot-and-mouth disease (FMD) is a trans-boundary animal disease that seriously disrupts regional and international trade in animals and animal products. The disease affects cattle, swine, sheep, goats and other cloven-hoofed ruminants (OIE, 2018). Foot-and-mouth disease virus can

spread rapidly in herds, populations and is difficult to control. Acute FMDV infection is characterized by loss of appetite, fever, and formation of characteristic vesicles on the feet, udders, and in the oral cavity (Orsel et al., 2009). The disease causes serious production losses including weight loss, decrease in milk production, and loss of draught power, the majority of affected animals recovered from FMD disease are often weakened and debilitated (OIE, 2018). FMD outbreaks have been occurring in many continents such as Asia, Europe, Africa, and South America. According to the World Reference Laboratory for Foot and mouth disease in 2020, FMD occurs in 37 countries around the world (WRLFMD, 2020).

In Vietnam, types O, A and Asia 1 were found in infected animals. It was found that 22.3% of sampled ruminants had previously been infected with the FMD virus, of which 10.8% were persistent and asymptomatic carriers (Ferreira et al., 2015). Thereafter, the disease continued to spread throughout the country due to errors in FMD disease control and prevention (Truong, 2017). Risk factors for recurrence of FMD outbreaks were determined including the movement of infected animals, exposure to infected wild animals, long periods between vaccination and infection, proximity to borders, lack of suitable biosecurity (Rweyemamu et al., 2008). According to data reported by MARD (2019), Foot-and-mouth disease outbreaks have been occurring in many provinces: Ha Tinh, Quang Binh, Quang Tri, Quang Ngai causing great damage to the livestock industry in Vietnam. In Vietnam, control of FMD in endemic regions is mainly focused on mass vaccination of all susceptible livestock with a homologous strain vaccine, identification, and testing of animals, establishment of protection and surveillance zones and enforcement of quarantine and biosecurity. FMD vaccine has been recommended in the routine vaccination program for animals according to Decision no. 07/2016/ Ministry of Agriculture and Rural Development (MARD, 2016) about the national program of controlling FMD disease issued in 2016. Besides, the serological survey for antibodies against FMDV was carried out in this program. Therefore, this study aimed to evaluate the seroprevalence of FMD virus in vaccinated pigs and cattle in Cu Chi and Hoc Mon, Ho Chi Minh City.

Descriptive analysis and Chi-square tests were used to compare the difference in proportions of seroprevalence among herd size, breeds, and other variables. If the probability value ($P$-value) is less than or equal to the set alpha level (0.05) then the result was considered as statistically significant.

## 2. Materials and Methods

A total of 535 pig and 366 cattle sera were taken from 37 pig farms and 56 households in 11 communes of Cu chi (An Nhon Tay, An Phu, Nhuan Duc, Pham Van Coi, Phuoc Vinh An, Thai My, Tan Thanh Dong, Tan Thanh Tay, Trung Lap Thuong, Trung Lap Ha, Trung An) and two communes of Hoc mon districts (Tan Thoi Nhi, Xuan Thoi Son) Ho Chi Minh City. All animals were originally collected as part of on-going annual disease investigations. These animals in this study were vaccinated against foot and mouth disease. In each pig farm, depending on herd size and the permission of owners, 5 – 100 pigs were collected randomly for blood sampling. Meanwhile, all vaccinated animals per cattle household would be selected for 3-5 mL blood samples to evaluate the seroprevalence of FMD. For each sampled animal, information including regions, herd size, days post-vaccination were also collected to assess their association with FMD seropositivity. All serum samples were tested for the presence of antibodies against FMD antibody detection serotype O (Pirbright, UK).

Descriptive analysis and Chi-square tests were used to compare the difference in proportions of seroprevalence among herd size, breeds, and other variables. If the probability value ($P$) is less than or equal to the set alpha level (0.05) then the result was considered as statistically significant.

## 3. Results and Discussion

Table 1 showed that the proportions of positive pigs and cattle for antibodies against FMDV serotype O were over 80.00% which met the demand of the Sub-department of Animal Health Ho Chi Minh scheme (Decision no. 07/2016/TT-BNNPTNT). However, the seroprevalences of vaccinated pigs against FMD virus serotype O in Xuan Thoi Thuong, Thai My and Phu My Hung were 68.18%; 44% and 8.19%; respectively, which were not achieved complete protection from FMD disease. It is likely that poor handling and malpractice in FMD vaccination in farms belonged to Xuan Thoi Thuong, Thai My and Phu My Hung

**Table 1.** The seroprevalence of antibodies against FMDV type O in vaccinated pigs and cattle by regions

| | Communes | Pig | | Cattle | |
|---|---|---|---|---|---|
| | | Number of households | n/N (%) | Number of households | n/N (%) |
| Cu Chi | Trung Lap Thuong | 4 | 62/71 (87.3) | 1 | 5/5 (100.0) |
| | Thai My | 2 | 3/10 (30.0) | 2 | 9/10 (90.0) |
| | Trung An | 3 | 10/10 (100.0) | 2 | 8/10 (80.0) |
| | Tan Thanh Dong | 3 | 8/10 (80.0) | 2 | 10/10 (100.0) |
| | Trung Lap Ha | 3 | 10/10 (100.0) | 2 | 10/10 (100.0) |
| | Pham Van Coi | 1 | 100/100 (100.0) | 1 | 27/27 (100.0) |
| | An Nhon Tay | 5 | 126/132 (95.5) | 3 | 34/35 (97.1) |
| | Nhuan Duc | 4 | 70/71 (98.58) | 13 | 43/45 (95.6) |
| | Tan Thanh Tay | 3 | 15/15 (100.0) | 11 | 44/45 (97.8) |
| | Phuoc Vinh An | 3 | 7/8 (87.5) | 11 | 42/45 (93.3) |
| | An Phu | 4 | 15/15 (100.0) | 5 | 58/67 (86.6) |
| | Phu My Hung | 1 | 5/61 (8.2) | - | - |
| | Total | 36 | 431/513 (84.0) | 53 | 290/309 (93.9) |
| Hoc Mon | Tan Thoi Nhi | - | - | 1 | 24/24 (100.0) |
| | Xuan Thoi Son | - | - | 2 | 31/33 (93.9) |
| | Xuan Thoi Thuong | 1 | 15/22 (68.2) | - | - |
| | Total | 1 | 15/22 (68.2) | 3 | 55/57 (96.5) |

n: number of positive samples; N: number of serum samples tested.

occurred and this leads to the failure in FMD vaccination in these pigs. In reality, the owners were responsible for vaccination programs in a pig farm and the information about these pigs such as vaccination programs were collected by using questionnaire lists. In addition, Dekker et al. (2016) also indicated that piglets should be vaccinated when maternal antibodies titers are at a very low level to induce a neutralizing antibody titer likely to confer protection in these pigs. To achieve complete protection of pigs at the herd level, the seroprevalence of vaccinated pigs against FMD virus serotype O should be maintained at least at more than 80%; because it is generally considered that vaccination of not less than 80% of the herd is necessary to provide herd immunity (Doel, 1999). In this study, pigs showed low immunogenicity and protective effects compared to those in cattle. In consistent with Orsel & Bouma (2009) and Park et al. (2017), the results indicated that vaccination against FMD seemed to be effective in cattle and sheep, but was less effective in pigs.

Furthermore, in Table 2, no statistical difference was found in the seroprevalence of vaccinated pigs against FMDV serotype O among types of animals and age groups ($P > 0.05$). However, significant differences in the seroprevalence of vaccinated pigs across herd sizes and days post-vaccination ($P < 0.05$) were found. A survey in Minnesota indicated the effect of herd size on the herd protection after vaccination including the efficiency, duration as well as coverage level (Miller et al., 2018).

To manage big herd size, health management and vaccination should be carried out strictly because unvaccinated pig can become a reservoir as well as transmit pathogen to other houses and environments (Lyon et al., 2016). According to Decision 7 of MARD (2016), for post-vaccination surveillance of infectious diseases including FMD disease; Pasteurellosis, Leptospirosis, Tuberculosis in cattle, blood samples should be collected after 21 days to 90 days since the last vaccination. Additionally, a previous study have demonstrated that viruses can persist in the epithelium of pharynx in over 50% of cattle exposed to the virus, even in immunized animals so the longer protection can prevent pig from FMD infection (Kitching et al. 2003). According to Parida (2009), unlike cattle are more susceptible to aerosols and should be vaccinated with single or multiple administration as per requirement in free or endemic areas; pigs can excrete large amount of virus in aerosol, so pigs should been vaccinated to control the spread of virus and then culled of in-contact pig herds.

**Table 2.** The seroprevalence of antibodies against FMDV type O in vaccinated pigs and cattle based on types of animals

| | | Number of tested samples | Number of positive samples | Ratio (%) |
|---|---|---|---|---|
| Types of animals (animals) | | | | |
| Pigs | Sow | 61 | 61 | 100.0 |
| | Gilt | 64 | 53 | 82.9 |
| | Grower | 410 | 332 | 80.9 |
| Cattle | Dairy | 299 | 280 | 93.6 |
| | Beef | 67 | 65 | 97.0 |
| Months of age (months) | | | | |
| Pigs | 6 - 12 | 64 | 53 | 82.9 |
| | 12-36 | 471 | 393 | 83.4 |
| Cattle | $<12$ | 5 | 5 | 100.0 |
| | $\geq 12$ - $< 36$ | 64 | 62 | 96.9 |
| | $\geq 36$ - $\leq 60$ | 297 | 278 | 93.6 |
| Herd sizes (animals) | | | | |
| Pigs | $\leq 100$ | 123 | 94 | 76.4 |
| | $> 100$ - $\leq 500$ | 7 | 7 | 100.0 |
| | $> 500$ - $\leq 1000$ | 122 | 66 | 54.1 |
| | $> 1000$ - $\leq 5000$ | 122 | 122 | 100.0 |
| | $> 5000$ | 161 | 157 | 97.5 |
| Cattle | $< 20$ | 91 | 87 | 95.6 |
| | $\geq 20$ - $\leq 40$ | 139 | 134 | 96.4 |
| | $> 40$ | 136 | 124 | 91.2 |
| Time of vaccination (days) | | | | |
| Pigs | $\leq 21$ | 15 | 8 | 53.3 |
| | $> 21$ - $\leq 90$ | 258 | 198 | 76.7 |
| | $> 90$ | 262 | 240 | 91.6 |
| Cattle | $< 21$ | 91 | 87 | 95.6 |
| | $\geq 21$ - $\leq 40$ | 139 | 134 | 96.4 |
| | $> 40$ | 136 | 124 | 91.2 |

## 4. Conclusions

In conclusion, pigs showed low immunogenicity and protective effects compared to those in cattle. However, most farms had positive pigs and cattle for antibodies against FMDV serotype O met the demand of the Sub-department of Animal Health Ho Chi Minh scheme, except Xuan Thoi Thuong, Thai My and Phu My Hung.

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