



Study of factors influencing the success of foot and mouth disease (FMD) vaccination in beef cattle in North Sumatera Province

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Abstract

Vaccination is one of the important measures in controlling FMD in livestock. Therefore, to assess the success of FMD vaccination in livestock, it is necessary to evaluate the immune response of vaccinated animals in field conditions. This research aims to examine the effectiveness of foot and mouth disease (FMD) vaccination in North Sumatra Province and the factors influencing its success. The calculations using multiple logistic regression showed that the factors that significantly influence the effectiveness of FMD vaccination are time of vaccination, maintenance system, disinfection of cages, and farms implementing biosecurity. Based on the research that has been carried out, the advice that can be given to the North Sumatra Provincial Government is to pay attention to small-scale breeders. Because many smallholder farmers still lack knowledge, especially in implementing biosecurity.

Keywords: Cattle, foot and mouth disease, risk factors, vaccination

Citation: Hutagaol, N.M., Tafsir, M., & Faisal, F. (2024). Study of factors influencing the success of foot and mouth disease (FMD) vaccination in beef cattle in North Sumatera Province. *The International Journal of Tropical Veterinary and Biomedical Research*, 9(2), 42-46.

Introduction

Cattle, especially beef cattle, are one of the resources for producing food in the form of meat, which has high economic value (Siregar, 2009). Beef has enormous benefits for fulfilling nutritional intake in the form of animal protein in the human body. Until now, beef has been a food commodity that is high in protein and has a higher price than other food ingredients. However, this potential has risks because it deals with cases of animal disease, which can affect the economic value of livestock. In order to increase livestock production, animal health aspects cannot be separated, especially controlling animal diseases. The provision of animal products and live livestock is required to ensure that health aspects are free from zoonotic and non-zoonotic diseases.

One of the important diseases that needs to be considered in the context of raising cattle in North Sumatra is foot and mouth disease (FMD). Foot and mouth

outbreaks in Indonesia have occurred several times since this disease was first introduced in 1887 through cattle imports from the Netherlands. The last FMD outbreak occurred on the island of Java in 1983 and could be eradicated with a mass vaccination program. Indonesia was declared an FMD-free country in 1986 through Minister of Agriculture Decree No. 260/1986 and then recognized by the office of the International des Epizooties (OIE) in 1990 with resolution no XI (Ditkeswan, 2022).

Foot and Mouth Disease is an important transboundary disease because it spreads quickly. Clinical symptoms of FMD are characterized by the formation of vesicles/blisters and erosion in the mouth, tongue, gums, nostrils, nipples, and on the skin around the nails. Foot and mouth disease can cause large economic losses due to decreased production and become an obstacle in the trade of animals and their products. Indonesia has been declared free

of FMD since 1986. However, since April 28 2022, FMD has been declared to have reappeared in Indonesia through the Decree of the Minister of Agriculture No. 403/KPTS/OT.050/M/05/2022 concerning determination of FMD outbreak areas in several Regencies in East Java Province and Ministry of Agriculture Decree No. 404/KPTS/PK.300/M/05/2022 in Aceh Tamiang Regency, Aceh Province and then spread to other Regencies/Cities in Aceh Province. The government responded to the FMD outbreak with disease control measures by vaccinating cattle against FMD (Ditkeswan, 2022). Based on iSikhnas data, in 2022, the number of livestock infected with FMD was 22,791 heads and in 2023 as many as 46 heads were reported in iSikhnas.

Vaccination is one of the important measures in controlling FMD in livestock. Therefore, to assess the success of FMD vaccination in livestock, it is necessary to evaluate the immune response of vaccinated animals in field conditions. This can illustrate the extent to which the effectiveness of the PMK vaccination program has been implemented. In implementing vaccination, several factors influence vaccination, including the type of vaccine (CAVac, Aftopor), age of the animal, time of vaccination, post-vaccination sampling distance, maintenance system, type of cow feed given, disinfection treatment with disinfectants on pens, farm locations bordering on fence, implementation of biosecurity, and giving anthelmintics before cows are vaccinated against PMK (Yudhie, 2010). The aim of this research is to examine the effectiveness and factors that influence the success of foot and mouth disease vaccination in North Sumatra Province.

Materials and Method

Research materials

The tools used in this survey were micropipette tips, plain vacutainer tube, venoject needle, holder, coolbox, tissue roll, sticker paper, latex gloves, mask, cotton, 70% alcohol, Phosphate Buffer Saline (PBS), Eppendorf microtip, commercial ELISA Kit FMD Type O (IDvet®, France), multichannel pipette, single channel pipette,

computer ELISA reader, and sterile distilled water.

The test material is a serum sample from a vaccinated cow. The sample population came from sub-districts that had been vaccinated using the PMK serotype O vaccine with the product names CAVac® and Aftopor®.

Research methods

The number of samples taken was 76 animal samples from each selected village. So, the effective sample size for a multistage random cluster sampling design is: Effective sample size = simple random sampling (SRS) sample size *D = 76x30 = 2,280 individuals. So, the total villages that must be sampled are: 2,280/76 = 30 villages. This means that a minimum of 30 villages are the sampling targets in one province. The number of 28 regencies/cities in North Sumatra Province free from FMD was sampled 30% to eight regencies, namely Asahan, Batubara, Simalungun, Karo, Deliserdang, Langkat, Labuhan Batu, and Serdang Bedagai Regency.

The independent variables in this study include the type of vaccine, age of the animal, time of vaccination, post-vaccination sampling distance, rearing system, type of cow feed given, whether the pen is disinfected with disinfectant, whether the farm location is bordered by a fence, whether the farm implements biosecurity and whether anthelmintics were given before the FMD vaccine. The following is the formula for logistic regression in general, with the dependent variable (Y) being a linear function of k independent variables (X):

$$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10}$$

Information:

Y = Dependent variable or response variable

X = Independent variable or predictor variable

α = Constant

β = Slope or coefficient estimate

Y= Antibody titer (OD)

Results and Discussion

The samples in this study came from eight regency, namely Asahan, Batubara, Deli Serdang, Karo, Labuhan Batu, Langkat, Serdang Bedagai, and Simalungun Regency with a total of 30 villages and 269

respondents in North Sumatra Province. The following are the results of a study on the effectiveness of descriptive analysis and statistical analysis from eight regency in North Sumatra Province.

Table 1. Results of a study on the effectiveness of PMK vaccination in eight districts in North Sumatra Province (tails)

Regency	Number of livestock	Positive value of antibodies	Antibody negative value	Average (%)
Asahan	152	148	4	97.4
Batubara	380	377	3	99.2
Deli Serdang	228	226	2	99.1
Karo	76	74	2	97.4
Labuhan Batu	228	219	9	96.1
Langkat	456	410	46	89.9
Serdang Bedagai	152	147	5	96.7
Simalungun	608	550	58	90.5
Total	2280	2151	129	95.8

Table 2. Results of analysis of risk factors

Information	Sig.	OR	CI (95%)	
			Lower	Upper
Time to vaccinate	0.00	2.4	1.468	3.925
Maintenance system	0.022	0.53	0.308	0.914
Disinfecting the cage	0.056	0.588	0.341	1.015
Farms implementing biosecurity	0.00	2.752	1.815	4175

Table 1 obtained with a livestock population of 2,280 heads obtained positive results with a total of 2,151 heads, and the results of the positive effectiveness value of antibodies against FMD were the highest, namely in Batubara Regency, namely 99.2% and Deli Serdang Regency, the positive effectiveness value of antibodies against FMD was 99.1%. The positive effectiveness value of antibodies against FMD in Asahan Regency is 97.4% and in Karo Regency the positive effectiveness value of FMD antibodies is 97.4%. Labuhan Batu Regency with an effectiveness value of positive antibodies against FMD, namely 96.1%, Langkat Regency with an effectiveness value of antibodies against FMD, namely 89.9%, and Serdang Bedagai Regency with a positive effectiveness value for PMK antibodies, namely 96.7%. The lowest positive effectiveness value for antibodies against FMD was in Langkat Regency, namely 89.9%. From eight districts, the positive effectiveness value of

antibodies against FMD was obtained at 95.8%.

The results of the calculation of several variables processed with multiple logistic regression, the final results show that X3, X5, X7, and X9 are factors that influence the success of vaccination. For X3, namely the time of vaccination, X5 is the maintenance system, X7 is disinfecting the cage, and X9 is the farm implementing biosecurity.

Factors that influence the effectiveness of FMD vaccination include the time of vaccination, maintenance system, cage disinfection, and the implementation of biosecurity. Understanding and paying attention to these factors is important in designing and implementing effective vaccination programs to control FMD on farms. The beginning of the outbreak of FMD in Indonesia is the impact of the policy of importing meat and live livestock from countries that do not yet have FMD-free status, such as India. Farm animals infected

with FMD can be identified by looking at clinical symptoms, namely the formation of vesicles/blisters and erosion in the mouth, tongue, gums, nostrils, nipples and on the skin around the nails (Hamdu, 2019). The spread of FMD disease in livestock causes significant losses in terms of livestock health and economics for farmers and breeders. Decreased production and hampered sales of animals and their derivative products are examples of economic losses experienced by many farmer-breeders (Tawaf, 2017). The spread of FMD disease in susceptible livestock occurs quickly and widely in several areas due to the movement of animals, their products, vehicles, and objects contaminated with the FMD virus. This indicates that knowledge of FMD disease is needed and appropriate treatment is a priority for the government and the community in eradicating its spread.

Vaccines are usually very adequate, but permanent and complete protection against infection is rare. Apart from that, education for the public and the good management of livestock are among the causes of the failure of vaccines to protect against disease. Vaccine effectiveness is determined by several factors related to the vaccine, pathogen, host, environment, and vaccination technique (Altman et al., 2017). The type of vaccine used has an important role in determining its effectiveness in protecting animals from FMD. The superiority of inactivated vaccines compared to live attenuated vaccines, or vice versa, must be considered based on disease characteristics and livestock conditions.

Although Aftopor and CAVac are two vaccines that are effective in preventing foot and mouth disease in cattle, there are differences in their composition, efficacy, and use. Farmers must consult with a veterinarian or livestock expert to choose the vaccine that best suits their needs and farm conditions. Aftopor is recommended for routine vaccination of cattle at high risk of FMD, or as part of a disease control program on affected farms. CAVac is recommended for routine vaccination in cattle to prevent FMD, and can be used as

an alternative or adjunct, depending on farmer preference and vaccine availability.

According to Surtina *et al.* (2022), measures to prevent FMD in livestock include vaccination, controlling and monitoring cattle traffic, limiting slaughter, treating animal by-products, controlling wild animals and vectors, administering vitamins, antiseptics, and antibiotics, and implementing biosecurity and biosafety. Meanwhile, control and eradication measures include disposal by destroying contaminated objects and decontamination using disinfectants to clean insects, cages, equipment, vehicles, and other objects.

The timeliness of vaccination also affects its effectiveness. Vaccination at the right time, according to the disease cycle and the animal's immune response, can increase protection against FMD. Post-vaccination sampling is important to evaluate the animal's immune response to the vaccine. The correct sampling timing allows for identifying the level of immunity formed and assessing the effectiveness of vaccination.

Environmental conditions and animal welfare also influence the effectiveness of vaccination. A good maintenance system, including adequate nutrition and effective stress management, can improve the immune response to the FMD vaccine. The cleanliness of cages and maintenance facilities is an important factor in controlling FMD. Regular and effective disinfection can reduce the risk of disease transmission and increase the effectiveness of vaccination. Implementing biosecurity on livestock also significantly impacts the effectiveness of FMD vaccination.

Biosecurity measures are carried out by limiting animal movements, regulating traffic and implementing monitoring, prohibiting the entry of livestock from other areas, especially those that are sick, acting firmly on quarantine, keeping animals in good condition with good maintenance management, and periodically carrying out sanitation and disinfection of pens and surrounding areas (Leestyawati, 2022).

Conclusion

The results of the effectiveness of FMD vaccination in eight regencies in North Sumatra Province, namely the effectiveness obtained positive value results with a total of 2,151 and the highest effectiveness value results were in Batubara Regency, namely 99.2% and Deli Serdang Regency 99.1%. The effectiveness value in Asahan Regency was 97.4%, and Karo Regency was 97.4%. Labuhan Batu Regency with an effectiveness value of 96.1%, Langkat Regency 89.9%, Serdang Bedagai Regency 96.7%, and Simalungun Regency 90.5%. The lowest effectiveness value was in Langkat Regency, namely 89.9%. Of the 8 regencies, the effectiveness value obtained was 95.8%. The results of calculations using multiple logistic regression obtained significant risk factors that influenced the effectiveness of Foot and Mouth Disease (FMD) vaccination, namely the time of vaccination, maintenance system, disinfecting cages and livestock implementing biosecurity. Based on the research that has been carried out, the advice that can be given to the North Sumatera Provincial Government is to maintain high vaccination effectiveness, namely up to 99.2%, by paying attention to the time of vaccination, maintenance system, disinfection of cages and livestock implement biosecurity.

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