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Effect of Foot and Mouth Diseases Vaccination on Basic Semen Quality Parameter in Bali Cattle

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Abstract

This study aimed to determine the effect of post foot and mouth diseases (FMD) vaccination on the basic semen quality in Bali cattle bulls. The data used in this study were semen collection data of 25 Bali cattle bulls at the National Artificial Insemination Centre (NAIC), Singosari. The paired sample t-test was performed to compare the response variable of individual motility (%), abnormality (%), spermatozoa concentration (x 10^6 cells), and semen volume (mL) from regular semen collection in post and pre-vaccination groups. The results showed no significant difference in semen individual motility ($t(74) = -1.72$, $p = 0.95$), abnormality ($t(74) = 2.06$, $p = 0.98$), spermatozoa concentration ($t(74) = -4.35$, $p = 1.00$), and semen volume ($t(74) = -0.11$, $p = 0.54$) in Bali cattle bulls before and after vaccination. This study concludes that the FMD's vaccination program for Bali cattle bulls did not have the potential to reduce the basic semen quality for Bali Cattle frozen semen production.

Keywords: Bali cattle, foot and mouth diseases, post-vaccinal effect, semen quality, vaccination

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INTRODUCTION

The OIE had declared Indonesia to be free of foot and mouth diseases (FMD) in 1990, but in May 2022, two provinces, East Java and Aceh, had another FMD outbreak that quickly expanded to other regions of Java, Sumatra, Kalimantan, and West Nusa Tenggara (Oktanella *et al*., 2023). To control the spread of FMD disease, efforts have been made to restrict livestock traffic from outbreak areas and conditional slaughter, in addition, the Indonesian government has also imported vaccines which will be followed by a mass vaccination program, especially in outbreak period starting in June 2022 (Sutawi *et al*., 2023).

The first FMD vaccination program was an emergency response that was devoted to the dairy cattle population and government breeding centers such as the National Artificial Insemination Centre (NAIC), Singosari which was mandated to produce frozen semen in Indonesia (Zainuddin *et al*., 2023).

Previous studies in countries with FMD endemic status have reported the effect of FMD vaccination on the semen quality of bulls and buffaloes of various breeds. Most of the studies reported a decrease in semen quality that varied from 10 days to 10 weeks (Perumal *et al*., 2013; Kong *et al*., 2013). However, several studies also reported that there was no effect of FMD vaccination on the semen quality of bulls (Gupta *et al*., 2017). Therefore, the purpose of this study was to evaluate the possible effect of vaccination that could lead to a decrease in the quality of ejaculate semen for indigenous Indonesian Bali cattle semen-donor bulls.

MATERIALS AND METHODS

Ethical Approval

The current study did not require animal ethics approval. However, this study was carried out according to standard operating procedures.

Study Period and Location

This study was conducted at the National Artificial Insemination Centre (NAIC), Singosari,

East Java Province, (7° 50'14.6 "S 112° 38'43.7 "E) from 8 June to 13 July 2022.

FMD Vaccine

FMD vaccination was conducted on June 22, 2022. The vaccine used was a 6PD50 Aftopor® (Merial) which contained purified inactive FMD antigen (Type O-3039, O-MANISA, and A22 IRAQ) in double oil emulsion adjuvant at a dose of 2 mL which was administered via intramuscular injection into the neck region muscle using an 18G needle in a 3 mL syringe. The vaccine was injected by veterinary paramedics under the supervision of the NAIC veterinary officer.

Semen Collection

During the study, semen collection was carried out from 25 Bali cattle aged between 6–12 years old. Each samples were individually housed in cages and subjected to identical feeding and environmental management conditions.

The semen collection process was run regularly with a frequency of once per week using an artificial vagina. The semen volume data was obtained directly by reading the scale on the artificial vagina collector tube after ejaculation.

Semen Examination

A total of 35 µl of semen was diluted into 3.5 mL of NaCl 0.9% as a sample to determine the value of sperm concentration, individual movement, and abnormalities. The sperm concentration data was obtained by examining a semen dilution sample using Minitube® Photometer SDM6 (Prihatin *et al*., 2017). Furthermore, the sperm individual motility and abnormality were obtained by examining the micro-droplets of the semen dilution sample on an object glass in the examination chamber of the Hamilton Thorne IVOS II CASA system at a temperature of 37°C.

Data Analysis

For analysis, the data were categorized as follows: 1) The semen collection from June 8th to 22nd refers to the pre-vaccination semen collection, and 2) The semen collection from June 23rd to July 13th refers to the post-vaccination semen collection. Parameters observed included individual motility (%), abnormality percentage (%), spermatozoa concentration (x 10^6), and semen volume (mL). Furthermore, the semen parameters from the collections before and after FMD vaccination were statistically analyzed using a paired t-test in a one-tailed hypothesis assuming vaccination will decrease semen quality with a confidence level of 95% using JASP open-source software.

RESULTS AND DISCUSSION

In the present study indicated no significant difference results for individual motility on post-vaccination (M = 80.90, SD = 8.06) over pre-vaccination (M = 78.51, SD = 10.86), t(74) = -1.72, p = 0.95 and not a significant difference for sperm concentration on post-vaccination (M = 1435.00, SD = 437.11) over pre-vaccination (M = 1266.75, SD = 422.60), t(74) = -4.35, p = 1.00 in Bali cattle bull. These results were in line with those reported by Gupta *et al*. (2017). The analysis results from the parameters of individual motility (%), abnormalities (%), concentration, and volume of 25 Bali cattle semen-donor bulls before and after FMD vaccination are present in Table 1.

Adverse effects arising from FMD vaccination have been reported previously to reduce the semen quality of *Bos indicus, Bos taurus,* and Crossbred cattle (Dinana *et al*., 2023). Most authors have reported decreases in individual motility and spermatozoa concentration after FMD vaccination (Wei *et al*., 2013; Sirohi *et al*., 2016). Spermatozoa abnormalities were not significantly different in semen on post-vaccination (M = 5.70, SD = 3.40) over pre-vaccination (M = 6.70, SD = 5.30), t(74) = 2.06, p = 0.98. These results are contrary to those previously reported by Perumal *et al*. (2013) in Mithun bull semen following FMD vaccination. Furthermore, Sirohi *et al*. (2016) and Gupta *et al*. (2017) also reported an increase in abnormalities in the head, midpiece, and tail of Frieswal and Friesian Holstein bull's spermatozoa due to FMD vaccination.

Table 1. Semen parameters of Bali cattle before and after FMD vaccination

Semen Parameters	Pre-Vaccination Mean ± SD	Post-Vaccination Mean ± SD	t	p
Individual motility (%)	78.51 ± 10.86	80.90 ± 8.06	-1.72	0.95
Abnormality (%)	6.70 ± 5.30	5.70 ± 3.40	2.06	0.98
Concentration (x 10^6 cell/mL)	1266.75 ± 422.60	1435.00 ± 437.11	-4.35	1.00
Volume (mL)	6.01 ± 2.33	6.05 ± 2.34	-0.11	0.54

$p < 0.05$ considered as a significant difference between groups.

The results of our study also did not show any significant difference in the parameters of ejaculate volume on post-vaccination (M = 6.05, SD = 2.34) over pre-vaccination (M = 6.01, SD = 2.33), t(74) = -0.11, p = 0.54. Our study results are per most of the similar reports on semen volume parameters (Gupta *et al*., 2017; Wijayanti *et al*., 2023). However, increased variability in the ejaculate volume of exotic and crossbreed cattle (Hanifah *et al*., 2020; Iskandari *et al*., 2020).

In general, reactions to vaccination are categorized as local and systemic (Kristanto and Septiyani, 2023). Manifestations of local reactions due to vaccination include pain, swelling, and redness at the injection site while systemic reactions due to vaccination include fever, irritability, drowsiness, and even rash (Pisestyani *et al*., 2023). Systemic reactions after vaccination in humans and animals may result from type I hypersensitivity or anaphylaxis, complex type III mediated hypersensitivity, problems with adjuvant and contamination, and reactions due to endotoxins (Parihar and Chauhan, 2021). The adverse effects on semen quality that appear after vaccination are caused by anaphylactic reactions that induce a temporary increase in body temperature as well as testicular temperature affecting spermatogenesis and epididymal function (Purnama *et al*., 2019). Body regulation maintains the testes' temperature at 2–7ºC below body temperature to produce normal sperm, a temporary increase in body temperature due to fever will result in a decrease in sperm concentration, individual sperm motility, and an increase in sperm abnormalities (Wilujeng *et al*., 2020; Aldahhan and Stanton, 2021).

In addition to the FMD vaccine, other post-vaccination adverse effects on semen quality have also been reported in other vaccination programs in cattle and buffalo (Bhakat *et al*., 2015; Rao *et al*., 2017). Adverse effects after inactivated FMD vaccination can occur due to the intrinsic of the vaccine, inappropriate practices from standardized vaccination provision, the underlying disease condition of recipient animals, and imperfect ways of vaccine administration (Zhang *et al*., 2018; Wajdi *et al*., 2021). However, the healthy condition of the Bali cattle bulls at the time of vaccination, appropriate vaccine handling, and the use of new and correct needles and syringes for each injection may minimize the risk of an anaphylactic reaction in the Bali cattle bull in our study.

CONCLUSION

It can be concluded that the FMD's vaccination program for Bali Cattle bulls did not have the potential to reduce the basic semen quality for Bali Cattle frozen semen production.

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AUTHORS' CONTRIBUTIONS

KWP: Conceptualization and drafted the manuscript. AA and TRM: Performed semen evaluation. ZNAR: Validation, supervision, and formal analysis. KWP: Performed the statistical analysis and the preparation of table. All authors have read, reviewed, and approved the final manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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