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SAT1 and SAT2 FMD Vaccine Strains:

Broad Antigenic Coverage Aligned with Current Epidemiological Needs

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Introduction

The emergence of SAT2 and SAT1 Foot-and-Mouth Disease Virus (FMDV) in several Middle Eastern countries during 2023 and 2025, respectively, represents an unusual and concerning event for the region. These serotypes pose a significant threat to livestock populations with little or no prior exposure, increasing the risk of severe outbreaks outside this region. In this context, the development of relevant SAT1 and SAT2 vaccine strains represents a timely and strategic intervention. This study presents the immunological evaluation SAT1 and SAT2 vaccines, demonstrating their ability to induce a strong and long-lasting immunity and broad cross-neutralizing immune responses. These results support their potential use in systematic vaccination programs and antigen banks for emergency reserves.

Materials and Methods

Monovalent vaccines were formulated in Argentina in compliance with Good Manufacturing Practices (GMP), as high-potency, water-in-oil single emulsion containing purified antigens of SAT2 OMN 2015 and SAT1 2020 vaccine strains. Potency of each monovalent SAT1 and SAT2 vaccine was assessed in FMD-seronegative cattle following a single 2 mL dose in controlled trials supervised by SENASA, the WOAH Foot-and-Mouth Disease Reference Laboratory based in Buenos Aires, Argentina. Virus Neutralization Tests (VNT) were performed according to the WOAH *Terrestrial Manual*. Cross-reactivity was evaluated by VNT at Pirbright Institute, the WRLFMD using sera from vaccinated cattle collected at 30 dpv against heterologous SAT1 and SAT2 strains.

Results

A single dose of each monovalent SAT1 and SAT2 vaccines induced robust homologous neutralizing antibody response (Figure 1).

Heterologous response analysis revealed that the SAT2 vaccine induced strong heterologous responses against viruses from topotypes V, VII, and XIV, detected between 2017 and 2023. Neutralizing antibody titers ranged from 1.92 to 2.82 log_{10} for all evaluated strains (Table 1).

Similarly, the SAT1 vaccine generated high neutralizing antibody titers against isolates circulating between 2015 and 2025, belonging to topotypes I, II, III, and VII, all exceeding the 1.5 log_{10} protective threshold (Table 2).

Figure 1. Potency in cattle of monovalent SAT2 OMN 2015 and monovalent SAT1 2020

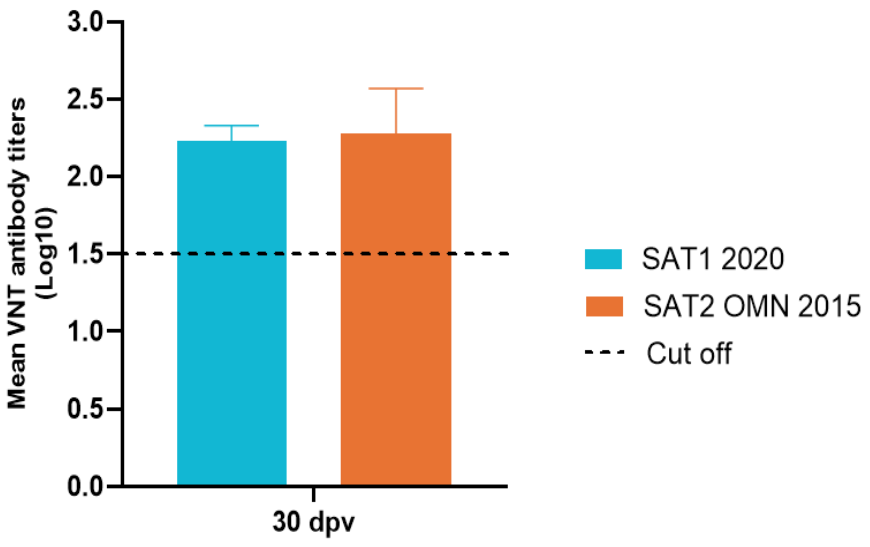

Table 1. Neutralizing antibody titers obtained with post-vaccination sera with monovalent SAT2 OMN 2015 vaccine against representative SAT2 isolates.

Topotype	Isolate	VN Titer
XIV	SAT2/JOR/26/2023	2.47
	SAT2/IRQ/5/2023	1.95
	SAT2/BAR 7/2022	2.49
	SAT2/ETH 3/2022	2.46
	SAT2/ETH 1/2023	2.48
	SAT2/IRQ 9/2023	2.63
	SAT2/JOR 20/2023	2.58
	SAT2/TUR 17/2023	2.70
VII	SAT2/ERI/19/2019	2.77
	SAT2/ETH/11/2018	1.92
	SAT2/NIG/51/2020	2.81
	SAT2/SUD/14/2017	2.56
	SAT2/EGY/1/2018	2.65
	SAT2/ERI/28/2019	2.81
	SAT2/ETH/31/2019	2.82
V	SAT2/ALG/4/2023	2.52
	SAT2/ALG/6/2023	2.67

Table 2. Neutralizing antibody titers obtained with Bovine post-vaccinal sera with monovalent SAT1 2020 vaccine against representative SAT1 isolates.

Topotype	Isolate	VN Titer
I	SAT1/QTR/5/2023	1.74
	SAT1/KEN/9/2020	2.53
	SAT1/IRQ/11/2025	1.87
	SAT1/BAR/50/2025	1.86
II	SAT1/ZIM/14/2015	1.83
III	SAT1/BOT/5/2015	1.68
VII	SAT1/UGA/14/2023	1.53

Conclusion

FMD vaccines containing SAT1 2020 and SAT2 OMN 2015 strains manufactured in Buenos Aires, Argentina showed strong immunogenicity and broad cross-reactivity against recent SAT1 and SAT2 isolates, supporting its strategic role in regional and global FMD control preparedness and programs.

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