

# IMMUNE RESPONSE OF CATTLE TO A QUADRIVALENT ALUMINIUM HYDROXIDE GEL FOOT-AND-MOUTH DISEASE VACCINE\*

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India is an endemic country for Foot-and-Mouth Disease. The economic loss to Indian dairy industry caused by FMD accounts to more than Rs. 5000 crores per annum (Manickam, 1998). Control of FMD in endemic countries is attempted by vaccination with polyvalent vaccines. The most commonly available FMD vaccine in India for last few decades was quadrivalent inactivated aluminium hydroxide gel vaccine. In the present study, immune response produced by an aziridine inactivated, quadrivalent FMD vaccine (O, A, C and Asia-1) adsorbed on aluminium hydroxide and adjuvanted with saponin was assessed in cattle.

## Materials and Methods

**Vaccine:** Aziridine inactivated, quadrivalent, aluminium hydroxide gel FMD vaccine (Raksha-Indian Immunologicals Ltd., Hyderabad) against FMD virus (FMDV) types O, A, C and Asia-1 was used for the study. The vaccine was procured from the manufacturer under cold chain and stored at +4°C until use.

**Animals:** Twelve unimmunized calves of four months of age were selected from Kerala Agricultural University livestock farms for the study.

**Vaccination schedule:** Vaccination of all the study animals was done as per the

manufacturer's regime. Primary vaccination was done at four months of age and a booster dose was given one month afterwards. A second booster dose was administered six months after the first booster dose. Three milliliters of vaccine was administered subcutaneously for each vaccination.

**Antigens and antisera:** BHK-21 cell adapted, aziridine inactivated O, A, C and Asia-1 FMD antigens were used. Type specific immune rabbit sera were raised against O, A, C and Asia-1 FMD viral antigens by two subcutaneous inoculations of corresponding inactivated 146s FMDV in Freund's Complete Adjuvant (FCA) as per the method of Have and Jensen (1983). Guinea pig antisera to O, A, C and Asia-1 FMDV types were raised by single inoculation of corresponding inactivated 146s FMDV (Ferris and Donaldson, 1984).

**Serum antibody assay:** Liquid Phase Blocking ELISA (LPB-ELISA) was carried out to assess the serum neutralizing antibody titres as per the method of Hamblin *et al.* (1986). The Optical Density (OD) values were read on a multiscan ELISA reader at 492nm and the fifty per cent end point of each serum dilution was assessed and expressed as log<sub>10</sub> antibody titres.

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Serum samples were collected from all the animals before vaccination and at monthly intervals for a period of one year following primary vaccination. All samples were inactivated at 56°C for 30 minutes and the serum neutralizing antibody titres were assessed by LPB

## Results and Discussion

The mean serum neutralizing antibody titres ( $SN_{50} \log_{10}$ ) against O, A, C and Asia-1 FMDV types obtained are presented in Table (1).

Paired t-test was used for the assessment of seroconversion between the serum titres of adjacent months as per Snedecor and Cochran (1994) and the t-values obtained are presented in Table (2).

The antibody titre required for protection against infection of FMD virus was taken as 1:20 ( $SN_{50} \log_{10} = 1.3$ ) regardless of the virus types (Bengelsdorff, 1989).

The mean antibody titres against all the four FMD virus types attained protective levels at 30 days post-vaccination. Animals responded well to the primary vaccination by significant rise in mean titres against all the four FMDV types. This result is in accordance with the observations made by Spath *et al.* (1995). A gradual decline in mean titres following the initial rise was observed. Augede-Mello and Gomes (1977) in a trial with

aqueous FMD vaccines observed highest antibody titres at 30 days post vaccination and a gradual decline thereafter. Following primary vaccination, the mean antibody titres against all the four FMD antigens remained above the protective level throughout the study period except during fifth month. A reduction in mean titres from third to fourth month was noted against FMDV type 'O' ( $P \leq 0.01$ ) and Type 'C' ( $P \leq 0.05$ ) and from fourth to fifth month against FMDV types 'A' and 'Asia-1' ( $P \leq 0.01$ ). An outbreak of FMD occurred in Kerala during those months and this could be the reason for this reduction. Eventhough none of the test animals suffered, a probable immunosuppression as a result of this outbreak could be the most probable reason for this poor response. Tizard (1994) described viral infections as one of the reasons for immunosuppression.

Effects of booster vaccinations were clearly evident against all the four FMDV types. There was significant rise in mean titres following booster vaccinations in first and seventh months.

For maintaining the protective level of immunity for a period of one year, three times administration of vaccine was needed. Rivenson *et al.* (1977) reported that aqueous FMD vaccines produced immunity of shorter period and repeated vaccinations at four months interval were needed.

**Table 1.** Monthly mean antibody titres (mean  $\pm$  SE) of cattle vaccinated by quadrivalent aluminium hydroxide gel FMD vaccine against four different FMD antigens

FMDV	Month												
Type	0	1	2	3	4	5	6	7	8	9	10	11	12
O	1.209± 0.150	1.681± 0.214	2.202± 0.248	1.813± 0.139	1.147± 0.115	1.149± 0.150	1.716± 0.176	1.716± 0.176	1.860± 0.115	1.662± 0.092	1.394± 0.121	1.522± 0.159	1.507± 0.136
A	1.054± 0.153	1.929± 0.202	1.893± 0.202	1.758± 0.104	1.580± 0.064	1.010± 0.098	1.885± 0.225	1.885± 0.225	2.032± 0.165	1.778± 0.193	1.697± 0.173	1.436± 0.199	1.646± 0.162
C	0.853± 0.121	1.803± 0.286	1.831± 0.191	1.898± 0.124	1.508± 0.104	2.023± 0.205	1.957± 0.133	1.957± 0.104	2.232± 0.072	1.975± 0.121	2.066± 0.107	1.813± 0.133	1.760± 0.089
Asia-1	1.023± 0.110	1.696± 0.162	1.904± 0.193	1.763± 0.104	1.671± 0.064	1.163± 0.089	1.747± 0.176	1.499± 0.144	1.864± 0.101	1.583± 0.127	1.580± 0.107	1.389± 0.095	1.485± 0.078



**Table 2.** Table of t-values calculated between the monthly antibody titres of cattle vaccinated with aluminium hydroxide gel FMD vaccine against four different FMD antigens

FMDV Type	Between months											
	0&1	1&2	2&3	3&4	4&5	5&6	6&7	7&8	8&9	9&10	10&11	11&12
O	2.002	2.337*	1.250	4.331**	0.014	2.074	0.321	0.649	1.902	2.969*	0.773	0.057
A	3.697**	0.133	0.647	1.822	7.477**	2.174	0.549	0.926	1.841	0.636	1.207	1.340
C	3.384**	0.092	0.254	2.393*	1.855	0.269	0.001	1.893	1.836	0.790	3.396**	0.354
Asia-1	3.049*	1.280	0.700	0.868	6.667**	2.368*	1.062	2.936*	3.354**	0.025	3.118**	0.710

Table values  $t_{11}$  : at 5% level : 2.201

at 1% level : 3.106

\* Significant at 5% level

\*\* Significant at 1% level

## Summary

Liquid Phase Blocking ELISA was found to be a satisfactory test for a seroconversion studies with FMD vaccines. Quadrivalent gel FMD vaccine was found to produce satisfactory immune response in calves. Primary vaccination produced immunity within a period of 30 days and booster vaccinations produced good anamnestic response.

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