IMMUNE RESPONSE OF CATTLE TO A QUADRIVALENT OIL ADJUVANT FOOT AND MOUTH DISEASE VACCINE*

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Abstract

During last few years, there is an increasing interest in the use of oil-adjuvant Foot and Mouth disease (FMD) vaccines against the traditional aqueous vaccine. In the present study, seroconversion produced by a quadrivalent oil-adjuvant FMD vaccine (containing inactivated O, A, C and Asia-1 antigens) in cattle was assessed over a period of one year. For this, twelve calves of four months of age were vaccinated with a commercial oil-adjuvant FMD vaccine at four months and nine months after primary vaccination. Serum neutralizing antibody titres against four virus types were assessed by Liquid Phase Blocking ELISA (LPB-ELISA) at monthly intervals. The mean antibody titres attained protective level in the first month itself and were maintained above protective level up to nine months following primary vaccination. Booster vaccination also produced significant response. The fall in mean titres during fifth month of study may be attributed to the immunosuppression due to an outbreak of FMD that occurred all over the state during that month. It is observed that oil-adjuvant vaccines produce satisfactory immunity in cattle for more than nine months.

Key Words : *Foot and mouth disease, oil-adjuvant vaccine, seroconversion, LPB-ELISA*

Vaccination is considered as the most effective method of control of Foot and Mouth Disease (FMD) in endemic areas. The most commonly used FMD vaccine in India has been an aqueous vaccine prepared from inactivated antigen adsorbed on aluminium hydroxide gel and adjuvanted with saponin. During the last few years, there is an increasing interest in the use of oil-adjuvant FMD vaccines all over the world. In the present study, seroconversion produced by the administration of a quadrivalent oil-adjuvant FMD vaccine in cattle was assessed by Liquid Phase Blocking ELISA (LPB-ELISA) for a period of one year.

Materials nd Methods

Vaccine: Inactivated, quadrivalent, oil-adjuvant FMD vaccine (Raksha- O Vac- Indian Immunologicals Ltd.) against FMD antigen types O, A, C and Asia-1 was used for the study. Vaccines were procured from the manufacturer and kept at 4°C until use.

Animals: Twelve healthy crossbred calves of four months and above age, which were not vaccinated against FMD, were selected for the study.

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

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prescribed by the manufacturer. Primary vaccination was done at four months of age followed by a booster dose nine months after the primary vaccination. Dose of vaccine used was two milliliters and route of administration was deep intramuscular at hip region.

Antigens and antisera: BHK-21 cell adapted, azridine inactivated O, A, C and Asia-1 antigens were used. Type specific immune rabbit sera were raised as per Have and Jensen (1983). Guinea pig antisera to the four different FMD virus types were raised by the inoculation of respective 140s antigen as described by Ferris and Donaldson (1984).

Serum antibody assay: Liquid Phase Blocking ELISA (LPB-ELISA) was carried out as per the method of Hamblin *et al.* (1986).

Serum samples were collected from all the animals before vaccination and at monthly intervals following primary vaccination for a period of one year. All the samples were inactivated at 56°C for 30 min and the serum neutralizing antibody titres were assessed by LPB-ELISA. The OD values were read on a multiscan ELISA reader at 492 nm. The fifty per cent end point of each serum dilution was computed and expressed as $\log_{10}$ antibody titres.

Results and Discussion

The mean serum neutralizing antibody titres (SN_{50} $\log_{10}$) obtained against the four types of FMD antigen are presented in Table 1 and Fig. 1.

Fig 1. Seroconversion of four different FMD antigens in cattle vaccinated with quadrivalent oil adjuvant vaccine

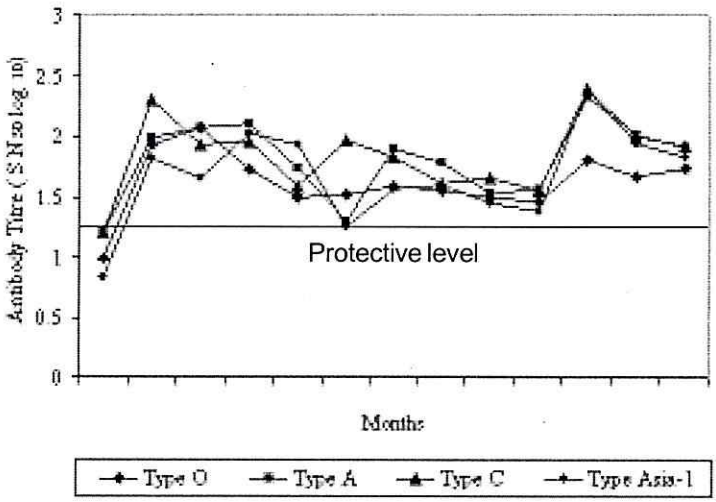


Table 1. Monthly mean antibody titres (mean ± SE) of cattle vaccinated by quadrivalent oil adjuvant FMD vaccine against four different FMD antigens

FMDV Type	Month												
	0	1	2	3	4	5	6	7	8	9	10	11	12
O	0.985± 0.107	1.932± 0.231	2.066± 0.133	1.727± 0.121	1.494± 0.130	1.519± 0.159	1.586± 0.139	1.551± 0.124	1.493± 0.107	1.458± 0.101	1.810± 0.127	1.671± 0.150	1.741± 0.162
A	1.210± 0.202	1.989± 0.240	2.069± 0.173	2.109± 0.159	1.738± 0.121	1.299± 0.115	1.899± 0.234	1.766± 0.170	1.532± 0.153	1.562± 0.133	2.319± 0.139	2.010± 0.136	1.913± 0.121
C	1.211± 0.208	2.294± 0.196	1.929± 0.228	1.958± 0.179	1.583± 0.176	1.962± 0.222	1.832± 0.147	1.613± 0.139	1.651± 0.147	1.556± 0.104	2.394± 0.095	2.003± 0.144	1.924± 0.136
Asia-1	0.823± 0.118	1.813± 0.196	1.654± 0.208	2.024± 0.165	1.927± 0.115	1.250± 0.115	1.563± 0.118	1.592± 0.156	1.450± 0.115	1.376± 0.136	2.375± 0.104	1.937± 0.153	1.823± 0.162

Table 2. t-values calculated between the monthly antibody titres of cattle vaccinated with oil adjuvant 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	3.647**	1.009	2.031	1.803	0.200	0.395	0.213	0.514	0.232	2.068	1.521	0.534
A	2.777*	0.410	0.155	2.366*	3.824**	2.200	0.858	1.534	0.154	5.851**	3.960**	0.928
C	4.153**	1.662	0.122	2.283*	2.002	0.479	1.718	0.272	0.593	5.698**	3.900**	0.711
Type Asia-1	3.782**	0.713	1.349	0.658	6.437**	1.763	0.176	1.258	0.684	6.705**	3.199**	0.631

Table values of t_{11}: at 5% level: 2.201at 1% level: 3.106 * significant at 5% level
** significant at 1% level

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 titres required for protection of cattle against FMD virus was taken as 1:20 (SN_{50} $\log_{10}$ =1.3) according to Bengelsdorff (1989) regardless of the virus type. The mean antibody titres of all the four types remained protective level during the entire period of study.

Type O: The mean antibody titre was 0.985 ± 0.107 before primary vaccination, which became 1.741 ± 0.162 during the twelfth month of study. There was a significant increase in mean type O titres (P<0.01) from 0.985 ± 0.107 to 1.932 ± 0.231 following primary vaccination during zero to first month.

Type A: Mean type A antibody titre of 1.210 ± 0.202 before vaccination became 1.913 ± 0.121 during twelfth month. A significant increase in mean type A titres (P<0.05) was noted during zero to first month and a reduction in titres from third to fourth month was also noted. The increase in mean type A titres from ninth to tenth month was significant (P<0.01). A highly significant reduction in mean titres (P<0.01) were observed during fourth to fifth month and tenth and eleventh month.

Type C: A mean type C antibody titre of 1.211 ± 0.208 before vaccination became 1.924 ± 0.136 at the end of the study. The increase in mean type C titres from zero to first month and ninth to tenth month were significant (P<0.01). Significant reduction in mean titres from third to fourth month and from tenth to eleventh month was also recorded.

Type Asia-1: The mean type Asia-1 antibody titre was 0.823 ± 0.118 before vaccination and 1.823 ± 0.162 during twelfth month. Highly significant increase in mean titres (P<0.01) observed during zero to first month and ninth to tenth month. The fall in mean type Asia-1 titres during fourth to fifth month and tenth to eleventh month were significant (P<0.01).

The mean antibody titres of all the four types attained protective level in the first month itself. Rao *et al.* (1993) compared the aqueous and oil-adjuvanted FMD vaccines in cattle and obtained satisfactory results with both the vaccines in first 21 days. Mc Kercher and Graves (1997) conducted trials with aqueous and oil-adjuvant vaccines and obtained higher immune response with the latter, whereas Mowat (1974) observed no significant difference between both types. Following the primary vaccination, the mean antibody titres against all the four FMD antigen types were above protective level except during fifth month. The fall in mean titres during this period may be attributed to the outbreak of FMD occurred all over the state during that month. An immunosuppression in all the animals occurred as a result of the FMD outbreak during these months can be the most probable reason for this poor response. None of the test animals were affected during this FMD outbreak, eventhough they showed a reduction in mean antibody titres. Tizard (1994) described viral infections as one of the reasons for immunosuppression.

Effects of booster vaccinations were clearly evident against all the four antigen types. Animals responded positively with significant increase in mean antibody titres during zero to first month and ninth to tenth month. The results obtained were in accordance with the observations of Spath *et al.* (1995).

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