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Homologous and heterologous antibody response following foot-and-mouth disease outbreak in vaccinated cattle

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Foot-and-mouth disease (FMD) is an extremely contagious viral disease of cloven-hoofed animals, most notably cattle, pigs, and sheep. Four serotypes of FMD virus namely A, O, C and Asia–1, have been reported in various outbreaks in India (Mohanty *et al.* 1994, Maan *et al.* 1998). Among these prevalent strains of FMD virus in India type O occupies the peak position (81.89%) (Singh and Singh 1998). FMD hits around 1% of country's livestock of more than 470 million each year in India (Pankaj *et al.* 2003).

The global spread of a pandemic strain of FMD virus and its detection in the UK in February 2001 have been traced to serotype O, Pan Asia strain (Knowles *et al.* 2001, Davies 2002).

The control of FMD in endemic countries is attempted by mass vaccination programme to develop a reliable immune barrier against FMD, but even then it is known to occur among vaccinated animals (Woolhouse *et al.* 1996, Jana and Maity 1997).

Monika *et al.* (2004) reported that in routinely vaccinated herd against FMD virus, the clinically infected animals and animals having mild exposure had higher antibody titres against serotype O following natural infection with FMD due to homologous antigenic stimulation of the immune responses.

The present study is an observation on the heterologous antibody response in vaccinated cattle clinically affected with serotype 'O' FMD virus.

Adult crossbred cattle (18), 3–11years-old, from an organized dairy farm were selected and vaccinated with a commercial aluminium hydroxide gel adjuvanted tetravalent FMD vaccine. The vaccinated animals were split into 4 main groups depending upon the previous history of vaccination of each animal (Table 1).

Group 1: Included animals vaccinated at least 6 times with aluminium hydroxide gel FMD vaccine.

Group 2: This group included animals which received 7–8 vaccinations.

Group 3: Animals of this group were vaccinated 8–10 times.

Table 1. Grouping of experimental animals on the basis of number of previous vaccinations with aqueous tetravalent FMD vaccine

	Group 1	Group 2	Group 3	Group 4
Number of vaccinations	6	7–8	8–10	10–18
Number of animals	820, 825, 826*, 827*, 829	801, 812, 813	668, 736*, 745, 751*	392, 447, 495, 514, 519, 642

*Animals from group 1 and 3 are also included in infected group.

Group 4: Animals of this group were vaccinated atleast 10 times.

Humoral immune response

Liquid phase sandwich blocking ELISA (LPb ELISA) was used for quantification of antibody titres in the serum samples as per Hamblin *et al.* (1986).

Serum samples (132) were collected and analyzed for the presence of antibodies against A, O, C and Asia–1 serotypes of FMD virus by liquid phase blocking sandwich ELISA. The pre-vaccination antibody titres of all the animals in groups 1, 2 and 3 against 4 serotypes ranged between <1.2

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Table 2. Serum antibody titres (log_{10} LPB ELISA titres) of infected animals against serotypes A, O, C and Asia–1 of foot-and-mouth disease virus

Serotype	Days post-vaccination (dpv)						
	0 (Pre-vacc.)	21	60	90	120	150	180
Group 1: Animal No. 826							
Serotype O	<1.2	1.38	1.38	<1.5	1.98	1.68	1.68
A	<1.2	1.68	1.38	1.5	1.98	1.68	1.68
C	<1.2	<1.2	<1.2	<1.5	1.5	1.2	1.38
Asia–1	<1.2	1.5	<1.2	1.5	1.38	1.5	1.5
Animal No. 827							
Serotype O	<1.2	1.2	<1.2	<1.2	1.68	1.38	1.38
A	<1.2	<1.2	<1.2	1.2	1.68	<1.2	1.38
C	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Asia–1	<1.2	1.5	<1.2	1.2	1.38	1.38	1.38
Group 3: Animal No. 736							
Serotype O	<1.2	1.38	1.38	<1.2	1.5	1.98	1.98
A	1.2	1.38	1.38	<1.2	1.68	1.98	1.8
C	<1.2	<1.2	1.38	<1.2	<1.2	1.68	1.68
Asia–1	<1.2	1.68	1.38	1.2	1.38	1.68	1.8
Animal No. 751							
Serotype O	<1.2	1.38	1.38	<1.5	>2.1	>2.1	>2.1
A	1.38	1.38	<1.2	1.5	>2.1	>2.1	>2.1
C	<1.2	1.2	<1.2	<1.5	1.68	1.8	1.8
Asia–1	<1.2	1.38	<1.2	<1.5	2.1	1.98	1.98

to 1.5. The animals in group 4 had higher pre-vaccination antibody titres ranging between 1.68–2.1.

Following vaccination at 21 dpv the antibody titres against 4 serotypes (A, O, C and Asia–1) did not rise significantly in comparison with the pre-vaccination antibody titres in 4 groups. At 64 dpv there was a natural FMD outbreak at the dairy farm owing to serotype 'O' FMDV. Outbreaks of FMD among routinely vaccinated cattle have also been reported by Woolhouse *et al.* (1996), and Jana and Maity (1997). Although no animal from the experimental group was infected till 90 dpv, but slight increase in the antibody titre against all the four FMDV serotypes at 90 dpv as compared to 21 dpv was observed. This could be due to booster effect of circulating virus at the farm.

At 120 dpv the antibody titres against all the serotypes in 4 animals (826, 827, 736, 751) rose remarkably as compared to the antibody titres at 21 dpv. During the same time, these 4 animals suffered from clinical FMD infection (Table 2).

Although the natural outbreak was observed with FMDV serotype O but there was a parallel increase in homologous antibody titre (serotype O) as well as the antibody titre against other 3 heterologous serotypes i.e. A, C and Asia–1.

Samina *et al.* (1998) reported that multivalent vaccines of FMDV are expected to elevate the antibody titres of atleast one heterologous serotype (not included in the vaccine) and to detect antibodies for an additional heterologous serotype not detected otherwise following monovalent vaccination.

Occasional findings in Kimron Veterinary Institute indicated that a certain percentage of the Israeli-Friesian cattle showed remarkable levels of antibodies to exotic FMDV strains following vaccination with local strains (Kalmar and Peleg 1972). Kalmar *et al.* (1972) presented evidence that the level and the spectrum of cross-reacting antibody to exotic types of FMDV are partially under genetic control.

SUMMARY

In the present study, a significant increase in homologous as well as heterologous antibody titres following the natural outbreak with serotype O FMDV, was recorded.

Two animals of group 2 and one of group 3 did not clinically suffer from the disease but showed remarkable increase in the antibody titre against all the 4 serotypes at 120 dpv as compared to 21 dpv. These animals might have suffered from mild or subclinical infection.

REFERENCES

Davies G. 2002. The foot-and-mouth disease (FMD) epidemic in United Kingdom 2001. *Comparative Immunology, Microbiology and Infectious Diseases* **25**: 331–43.

Hamblin C, Barnett I T R and Crowther J R. 1986. A new enzyme linked immunosorbent assay (ELISA) for detection of antibodies against foot and mouth disease virus. II. Application. *Journal of Immunological Methods* **93**: 123–29.

Jana D and Maity. 1997. Foot-and-mouth disease outbreak in vaccinated herds of cattle with atypical lesions and allergic reaction. *Indian Veterinary Journal* **74**: 79.

Kalmar E and Peleg B A. 1972. Non-specific neutralizing activity of bovine sera against various types of foot-and-mouth disease

virus II sera of adult cattle. *Refuah Veterinarian* **29**: 85–91.

Kalmar E, Peleg B A and Modan M. 1972. Non-specific neutralizing activity of bovine sera against various types of foot-and-mouth disease virus 2. Genetic control of non-specific neutralizing activity in calf sera. *Refuah Veterinarian* **29**: 91–102.

Knowles N J, Samuel A R, Davies P R, Kitching R P and Donaldson A I. 2001. Outbreak of foot-and-mouth disease virus serotype O in the U.K. caused by a Pandemic strain. *Veterinary Record* **148**: 258–59.

Maan S, Kumar A, Sharma R and Ahuja K L. 1998. Prevalence of foot-and-mouth disease virus types in North-West India (1994–96). *Indian Journal of Virology* **14**: 55–57.

Monika, Sawhney S M S, Sanyal A, Venkataramanan R, Ramneek, Randhawa S S and Oberoi M S. 2004. Characterization of humoral and cell mediated immune response following aluminium hydroxide gel adjuvanted foot-and-mouth disease vaccine in cattle. *Indian Journal of Animal Sciences* **74**: 693–700.

Pankaj P K, Das S, Ramachandran N and Kumar A. 2003. Perception of foot-and-mouth disease (FMD) crisis and its systematic control in India. *Indian Dairyman* **55**: 67–74.

Samina J, Zakay-Rones Z and Peleg B A. 1998. Homologous and heterologous antibody response of cattle and sheep after vaccination with foot-and-mouth disease and influenza viruses. *Virus Research* **50**: 107–17.

Singh K B and Singh P. 1998. Present status and recommendations for control of foot-and-mouth disease. *Punjab Veterinarian* **6**: 19–20.

Woolhouse M E J, Hydon D T, Pearson A and Kitching R P. 1996. Failure of vaccination to prevent outbreaks of foot-and-mouth disease. *Epidemiology and Infection* **116**: 363–71.