RESPONSE OF LAMBS TO VACCINATION AGAINST FOOT AND MOUTH DISEASE IN TUNISIA

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Five epizootics of foot and mouth disease (FMD) have been recorded in Tunisia since 1975, affecting cattle, sheep and goats. The last major epizootic of FMD occurred in 1989 and had interesting epidemiological features that distinguished it from previous epidemics. A total of 2,315 outbreaks were declared during the lambing season of 1989. The disease affected mainly sheep and the virus isolated was FMDV serotype O¹. The losses due to mortality reached 55,000 for sheep, mainly young lambs, and 79 cattle². Prior to 1989, only cattle were regularly vaccinated but, following the significant losses in sheep in the 1989 epidemic, this species was subsequently included in the vaccination program. The incidence of the disease reduced dramatically following the extension of vaccination to the ovine population. But, new introductions of FMDV type O resulted in 3 and 2 new outbreaks in 1994 and in 1999, respectively. Vaccination appeared effective both at terminating the 1989 epidemic and at preventing the new incursions in 1994 and 1999 from spreading. The objective of the present study was to check the cold chain and conservation of the vaccine, to determine the duration of the maternal immunity, the age at which young lambs can be vaccinated and to compare the evolution of antibody titers after vaccination of lambs with the same batch of FMD vaccine with or without a booster.

Materiel and methods
Animals: A total of 540 young lambs of local breeds aged 1 to 3 months from three flocks on State farms in Tunisia were selected. At 7 to 9 months of age, 134 of these lambs were vaccinated following different vaccination protocols.
Vaccine: one batch of a monovalent vaccine, supplied by a reputable European vaccine manufacturer, containing type O1Mateur strain that was isolated from 1989 FMD outbreak.
Vaccination protocol: 134 out of the 540 lambs that were kept in the flocks for breeding were randomly divided into two groups A and B. Each of the 66 lambs in group A was vaccinated against FMD with a vaccine available in the farm (group A). 68 lambs in group B were vaccinated using vaccine from the same batch but shipped...
by the manufacturer directly to the Veterinary Research Institute. 32 and 33 lambs randomly selected from group A and group B, respectively, received a booster injection using the corresponding vaccine 60 days post vaccination (groups A1 and B1). The groups which did not receive a booster injection were designated A0 and B0.

Collection and examination of sera: sera were collected from each animal for a period of 6 months before vaccination. After vaccination, sera were collected from each animal at 15, 30, 60, 75, 90, 120, 150, 180, 270, 365, 395, 425, 455 and 485 days post vaccination (dpv). Sera were examined for antibody to FMDV type 0, Manisa by liquid phase blocking (LPB) ELISA. Sera were titrated in two-fold dilutions between 1:16 and 1:2400. Titers were expressed as the reciprocal of last dilution at which more than 50% inhibition was recorded.

Data collection and analysis: Data on husbandry practices and details of the history of previous FMD infection or vaccination on farms were collected by means of a questionnaire and by examining clinical records. Statistical analysis was performed using SAS software. Titers were expressed as log values and analyzed as a continuous variable. A second analysis was carried out to examine the efficacy of vaccination by classifying animals as either susceptible (titer <1:100) or protected (titer >=1:100). In cattle, an LPB ELISA titer of 1:100 is considered protective. There is no comparable figure for sheep but it is reasonable to assume that the same titer can be considered protective in this species. The procedure ANOVA to test for the effect of the booster, vaccine conservation and the duration of immunity was used. Multiple comparisons of the means were performed according to the Newman-Keuls test.

Results
The efficacy of vaccination was assessed by calculating the mean titer for the various groups of animals on each occasion that they were sampled. No statistically significant difference was observed when comparing vaccines A et B at 0 (F^1_{132}=1,49; p=0,22) and 15 dpv (F^1_{132}=2,36; p=0,13). At 30 dpv, animals in group A showed an average titer higher than that of group B (F^1_{131}=8,05 p=0,005). At 60 dpv, No difference was observed in mean titers between the two groups (F^1_{131}=0,12; p=0,73). At 15 days post booster injection (75dpv), the titer of all the groups increased significantly. Groups which received a booster injection had their mean titers higher than that of the animals that did not receive the booster injection (F^3_{128}=31,31; p=1.10^-4; Newman-Keuls test: A1B1 A0B0, underlined groups are similar). At 30 days after the booster (days 90), the average titers decreases for the four groups, the difference remains significant in between the groups that received the booster (A1 and B1) and the groups without a booster (A0B0) (F^3_{127}=69,90; p=1.10^-4; A1B1 A0B0). Mean titers decreased over time, but there is always a significant difference between animals with a booster and those without 2 months (day 120; F^3_{127}=30,09; p=1.10^-4) and 3 months (day 150; F^3_{125}=9,38; p=1.10^-4) after the booster injection. At 7 months after the booster injection, the mean titers increased for all the groups with no significant difference between them (F^3_{122}=0,92; p=0,43). One year after vaccination, the average titers decreased dramatically. This situation was maintained...
at days 395, 425 and 455. At these dates the difference between the groups is no longer significant (J365; $F^3_{120}=1.01$; $p=0.39$) – (J395; $F^3_{119}=0.39$; $p=0.43$); (J425, $F^3_{119}=2.49$; $p=0.06$) – (J455; $F^3_{116}=1.68$; $p=0.17$). At day 485, the mean titers increased for the 4 groups; this increase in mean titer was significantly higher for the animals for group B1 ($F^3_{114}=3.87$; $p=0.01$; B1 A1 A0B0). The overall percentage of animals with protective titers, stratified by group and vaccination protocol is very low. The highest percentages of protected animals were 32% in group A0 and 26% in group B0 at 15 dpv. After the booster, these percentages increased to reach 94% in group A1 and 85% in group B1.

Discussion
The average titer in the group of animals receiving only one injection, never reached the protection level. This result confirms findings of previous studies. There is a statistically significant difference between the group vaccinated with the vaccine shipped to the IRVT and the one vaccinated with the vaccine stored in the farm at 30 dpv ($p <0.005$). However, the average difference between titers was only one dilution. At 15 days post booster, the mean titers increased for the animals in groups A0 and B0. Similarly, the percentage of animals with protective titers increased from 2% (group A) and 7% (group B) to 24% in both groups. At day 270, the mean titers increased significantly in all the groups. There is no significant difference between the four groups. This is explained by the fact that due to the occurrence of FMD in North Africa in 1999, a national vaccination campaign against FMD was undertaken in all the country.

References