Selection For Low Blood Gamma Globulin In Mink Naturally Exposed To The Aleutian Mink Disease Virus

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Introduction

Aleutian disease is an important health issue for the mink industry worldwide. Infection of adult mink by the Aleutian mink disease virus (AMDV) causes enhanced production of antiviral antibodies, massive destruction of white blood cells, viral persistency, and formation of immune complexes that deposit in various organs (Alexandersen, S., Bloom, M.E., Wolfinbarger, J. *et al.* (1987), Bloom, M.E., Kanno, H., Mori, S. et al. (1994)). Currently, the control measure for the disease is regular testing of mink for antibody against the virus by Counter-immune electrophoresis (CIEP) (Cho, H.J. and Ingram, D.G. (1972)) and elimination of infected mink. Although this costly practice has been effective in reducing the prevalence of infected animals, it has not been effective in eliminating the virus from several regions in Nova Scotia (Farid, A.**,** Finley, G.G. and Zillig, M.L. (2008)).

Development of the disease and severity of the disease symptoms depend on the genetic constitution of the mink, the strain of the virus and environmental conditions. While some mink color types can tolerate certain AMDV strains and do not develop clinical symptoms following infection, other color types suffer heavy losses (Porter, D.D., Larsen, A.E. and Porter, H.G. (1969), Hadlow, W.J., Race, R.E. and Kennedy, R.C. (1984)). Differences have been reported among individuals within color types in response to natural or experimental AMDV infection (Larsen, A.E. and Porter, D.D. (1975), An, S.H. and Ingram, D.G. (1977, 1978), Cho, H.J. and Greenfield, J. (1978), Hadlow, W.J., Race, R.E. and Kennedy, R.C. (1984, 1985), Aasted, B. and Hauch, H. (1988)). These data suggest that the creation of genetically resistant mink to the AMDV infection may be a possibility. The objective of this study was to investigate the prevalence of sero-positive animals on an infected ranch that has not been using CIEP as a selection tool.

Materials and Methods

This study was performed on a mink ranch that was established in 1944 in eastern Nova Scotia, Canada. Black mink have been kept on this ranch since its establishment, and some non-black mink that were kept on this ranch for several years were discarded in 1990. Since 1990, the breeding colony consisted of approximately 700 to 800 breeder females and 180 males. The herd has been closed to outside stock since 1995. The Iodine Agglutination Test (IAT) has been performed in December each year since 1966

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without interruption. Animals that were positive on the IAT were discarded from the herd at pelting season. In addition to IAT results, selection has been primarily based on litter size and fur quality traits. Mink with high quality fur have sometimes been retained for breeding even if they were born into smaller litters or produced small litters. A sample of 61 mink was tested by CIEP in 2000, but CIEP test has not been used as a selection tool on this ranch.

A total of 454 breeder females, 99 breeder males and 220 female kits were sampled in November 2004. Two blood samples were taken into capillary tubes from each mink by toe-nail clipping. One sample was used to determine the presence of AMDV-specific antibody by the CIEP at the Animal Health Laboratories, Nova Scotia Department of Agriculture, Truro, Nova Scotia. The second sample was tested for IAT by the owner on the ranch. Some samples showed inconclusive results by the CIEP test.

Results and discussion

The percentage of CIEP-positive mink was 84.4 (Table 1), which is comparable with the 84.7% positive cases on this ranch when 61 mink were tested in 2000, showing that the ranch has been heavily infected with the AMDV for at least six years. The percentage of positive mink on the IAT was 5.3. The proportion of IAT-positive animals has remained within the 5% to 10% range for almost two decades (personal communications). When serum gamma globulins rise over 20 to 22 % of total serum proteins, they precipitate in the presence of iodine. Therefore, the IAT test detects those mink that have an elevated level of gamma globulin, regardless of the source of infection.

IAT positive mink would be expected to either show clinical signs of Aleutian disease, i.e. they are really sick, or have other health problems, such as kidney malfunction. The IAT should therefore detect animals that are infected with AMDV in addition to those that are infected by other pathogens. IAT cannot, however, detect mink infected with the AMDV who fail to produce high levels of gamma globulins. Such animals will be detected by CIEP if they produce detectable levels of AMDV-specific antibody. The observations that only 5.3% of mink were positive on IAT while 84.4% were positive on CIEP suggest that a large percentage of mink on this ranch were infected with the virus but were not developing the disease symptoms. The virus has very likely low pathogenicity, and the long-term selection for IAT-negative mink favored those individuals that could tolerate the virus, i.e. those that become infected with AMDV but did not become ill and thus remain IAT negative.

Litter size has rarely been below 4.5 during the past two decades on this ranch, and kit and adult mortalities have been low, particularly during the cold winter months. This is surprising in view of the fact that a large percentage of mink on this ranch were infected with AMDV. The disease is expected to reduce litter size and increase mortality,

particularly at sub-zero temperatures. Survivability and reproductive performance have not been compromised on this heavily infected ranch because animals are tolerating the pathogen.
The percentages of adult females and males that were positive on IAT were 1.4 and 4.1, respectively, which were significantly lower than 13.6% for kits (Table 1). The corresponding figures for CIEP were 88.5%, 77.1% and 79.3%, respectively. These figures support the hypothesis that most animals become infected with AMDV during the first year of their lives, and only a small number of the clean mink become infected in later years. Those mink that had high levels of gamma globulin were detected by IAT and were removed from the herd. Only those that were not infected cleared the virus (CIEP negative) or those that were infected but were able to tolerate the virus were retained for breeding (CIEP positive and IAT negative).

Table 1: Distribution of the IAT and CIEP test results by age and sex

Description	Young females	Breeder females	Breeder Males	Total
Number of mink sampled and tested	220	454	99	773
No. of samples inconclusive on CIEP	3	19	3	25
Number tested by CIEP	217	435	96	748
Number positive on CIEP	172	385	74	631
% positive on CIEP	79.3	88.5	77.1	84.4
No. positive on IAT	30	6	4	40
% positive on IAT	13.6	1.4	4.1	5.3
CIEP positive- IAT positive, %	13.3	1.1	3.1	4.9
CIEP positive – IAT negative, %	65.9	87.3	74.0	79.4
CIEP negative – IAT positive,	0.5	0.2	1.0	0.4
CIEP negative – IAT negative, %	20.3	11.2	21.9	15.2

The joint distribution of animals based on IAT and CIEP test results is presented in Table 1. Most animals (79.4%) were CIEP positive but IAT negative, which are ADV-infected mink with low levels of gamma globulin. The percentage of animals that were positive on both tests was 4.9. These were animals with high levels of gamma globulin, very likely as a result of infection with AMDV alone or in combination with other pathogens. Only 0.4% of the mink were CIEP negative but IAT positive. These were possibly animals that were infected with pathogens other than AMDV.

Animals that were negative on both tests constituted the second largest group (15.2%). There are several plausible explanations for this group of animals: ii- they were exposed to the virus, but were not infected (resistant), ii- they were infected but cleared the virus from their bodies (resistant), iii- they were infected and were carrying the virus in their tissues, but the virus was not replicating. It seems that viral replication is required to trigger antibody production. These animals were thus tolerating the virus or iv- although it is unlikely, these animals may have never been exposed to the AMDV on this ranch

Conclusion

This study provided evidence that some mink may not become infected by the Aleutian mink disease virus or may clear the virus after infection.

References

Alexandersen, S., Bloom, M.E., Wolfinbarger, J. *et al.* (1987). *J. Virol.*, 61:2407-2419.

An, S.H. and Ingram, D.G. (1977). *Am. J. Vet. Res*., 38:1619-1624.

An, S.H. and Ingram, D.G. (1978). *Am. J. Vet. Res.*, 39:309-313.

Aasted, B. and Hauch, H. (1988). *Acta Vet. Scand.*, 29:315-321.

Bloom, M.E., Kanno, H., Mori, S. *et al.* (1994). *Infect. Agents. Dis.*, 3:279-301.

Cho, H.J. and Ingram, D.G. (1972). *J. Immunol.*, 108:555-557.

Cho, H.J. and Greenfield, J. (1978). *J. Clinical Microbiol.*, 7:18-22.

Farid, A.**,** Finley, G.G. and Zillig, M.L. (2008). *Scientifur*, 32 (4): 210-211.

Hadlow. W.J., Race, R.E. and Kennedy, R.C. (1984). *J. Virol.*, 50:38-41.

Hadlow, W.J., Race, R.E. and Kennedy, R.C. (1985). *J. Virol.*, 55:853-856.

Larsen, A.E. and Porter, D.D. (1975). *Infection & Immunity*., 11:92-94.

Porter, D.D., Larsen, A.E. and Porter, H.G. (1969). *J. Exp. Med.*, 130: 575-589.