blood mononuclear cells (PBMC) proliferation against the recombinant MPSP was detected afier the third inoculation. These results indicate that recombinant vaccinia virus can induce both humoral and cellular immunities. Following challenge with *T. sergenti*-infected erythrocytes, higher level of antibody responses as well as PBMC proliferations were detected in immunized calves compared to controls. However, immunized and control calves showed the same levels of parasitemia and packed cell volume (PCV). Therefore, immunization of calves with recombinant vaccinia virus did not confer protective anti-merozoite immunity. These present findings are based on observations done over on short period of time. The course of disease progression in the later stages of infection was not evaluated. Therefore, further experiments will be required to examine the potential of the vaccinia virus expression system as a control method for bovine theileriosis.

Appearance of apoptosis induced by Marek's disease virus infection

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Marek's disease virus (MDV), a causative agent of Marek's disease (MD) characterized by T cell lymphoma formation and peripheral nerve enlargement, causes immunosuppression in infected chickens. The immunosuppression can be divided into two phases ; the primary phase characterized by humoral immunosuppression, and the secondary one characterized by T cell unresponsiveness to mitogen stimulation. Previously, it was shown that $CD4^+$ $CD8^+$ T cells in the thymus and $CD4^+$ T cells in the spleen and peripheral blood underwent apoptosis at 1 and 3 weeks after MDV infection, respectively. However, the relationship between apoptosis and immunosuppression after MDV infection remains unclear.

In this study, to demonstrate the involvement of apoptosis in immunosuppression induced by MDV, lymphoid tissues, such as spleen, bursa of Fabricius, thymus and cecal tonsils, obtained from chickens experimentally infected with MDV were examined histologically. The immunohistochemical staining to detect MDV-specific phosphorylated protein, pp38, and TUNEL (Terminal deoxynucleotidyl transferase mediated dUTP-biotin nick end labeling) method were used in order to identify MDV-infected cells and apoptotic cells, respectively. TUNEL-positive cells were detected in bursa of Fabricius obtained from MDV-infected chickens at 1 to 3 weeks after infection. Throughout the experimental period, pp38-positive and TUNEL-positive cells were observed not only in primary lymphoid tissues such as the thymus and bursa of Fabricius, but also in secondary lymphoid tissues such as the spleen and cecal tonsils. These results suggest that MDV could induce apoptosis in several lymphoid tissues. In addition, the number of TUNEL-positive cells was higher than that of pp38-positive cells in those tissues. Since chickens were depressed and their thymus and bursa of Fabricius were severely atrophied at that time, apoptosis of uninfected cells may be one of the causes of immunosuppressions induced by

MDV-infection.

To further characterize the molecular events involved in this apotosis, the expressions of apoptosis-related genes, DAD1 and p52, were examined by Northern blotting. DAD1 has been reported to inhibit apoptosis while p52 can promote apoptosis in host cells. No differences in the expression levels of these genes in the lymphoid tissues were detected between infected and uninfected chichens during the experimental period.

In conclusion, apoptosis could play an important role in the immunosuppression caused by MDV. Since persistent immunosuppression will be essential for subsequent transformation, to study the mechanism(s) of the apoptosis would be necessary to understand the pathogenesis of MD.

Study on stomach nematodes (Anisakidae) among Steller sea lions, spotted seals and ribbon seals captured at northeast coast of Hokkaido, Japan

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Eight Steller sea lions (*Eumetopias jubatus*), 33 spotted seals (*Phoca largha*) and 28 ribbon seals (*Phoca fasciata*), captured off Rausu, eastern Hokkaido during the winter of 1997–98, were examined. All nematodes were found in the stomach cavity and at the stomach wall of the animals. The nematodes were categorized into 4 groups by their size and the number of worms were counted. Then, some of the adult worms and third- or fourth-stage larvae were picked up randomly and identified.

Steller sea lions harbored an average of 5,112±4,250 (S.D.) worms. Adult parasites found in the animal were *Pseudoterranova decipiens* (75.0%) and *Contracaecum osculatum* (37.5%), with the former as the dominant species. *P. decipiens* was found in 6 animals and consists more than 70% of all adults identified. Larvae of *Anisakis simplex* (75.0%), *P. decipiens* (100%), *C. osculatum* (75.0%) and *Phocascaris* sp. (75.0%) were found. However, adults of *A. simplex* and *Phocascaris* sp. were not found, suggesting that these worms hardly establish in this host. *P. decipiens* are primary species in Japanese waters but *C. osculatum* are found more often in Alaska, USA. It is suggested that the different food resources causes the difference in nematode fauna.

Spotted seals harbored an average of 748± 820 (S.D.) worms. *P. decipiens* (84.4%) was dominant among adult and adult parasites of *P. cystophorae* (15.6%) were also found. Larvae of *A. simplex* (81.3%), *P. decipiens* (100%), *C. osculatum* (56.3%) and *Phocascaris* sp. (34.4%) were found, with *P. decipiens* as the dominant species. *A. simplex* and *C. osculatum* larvae were also commonly found in the animals, but adult worms of these species were not found. Because parasitism by the adults of these species is seldom reported, it seems that *A. simplex* and *C. osculatum* hardly develop in this host. The nematode abundnce of adult hosts was significantly larger than that of immature or pup hosts.

Ribbon seals harbored an average of 1,297±