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ONCORHYNCHUS MASOU VIRUS (OMV) EPIDEMIOLOGY AND CONTROL SYSTEM

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*La distribution des Herpèsvirus de Salmonidés est classiquement connue aux Etats-Unis et au Japon. Les virus isolés des Etats-Unis sont classés dans le sérotype 1, ceux du Japon appartenant au sérotype 2 (*Oncorhynchus masou *virus, ou OMV). L'infection par l'OMV est oncogène et se manifeste par des ulcérations cutanées. Les espèces les plus réceptives sont le kokanee (variété japonaise du saumon rouge,* Oncorhynchus nerka*), le saumon masou (*O. masou*), le saumon argenté, ou coho (*O. kisutch*) et la truite arc-en-ciel (*O. mykiss*). Les pertes économiques résultant de l'infection sont surtout ressenties chez le kokanee, le saumon coho et la truite arc-en-ciel. Au début des années 1980 l'OMV était déjà largement répandu dans le nord du Japon. On ne l'a isolé du saumon coho qu'à partir de 1988, et de la truite arc-en-ciel qu'à partir de 1991. Depuis, l'infection est devenue un problème majeur pour les élevages en cages flottantes de saumon coho du district de Tohoku, et pour la truiticulture en eau douce pratiquée à Hokkaido et dans la région centrale du Japon. L'OMV est sensible à l'irradiation par les rayons UV et au traitement par les iodophores. La détection des poissons porteurs est difficile, mais le virus se multiplie et devient détectable dans le liquide ovarien au cours de la maturation sexuelle. Pour lutter contre la maladie on a recommandé de désinfecter les oeufs, le matériel et les équipements d'élevage par les iodophores aussitôt après la fécondation, et de recommencer la désinfection des oeufs au stade "oeillé". Ces mesures se sont montrées efficaces.*

INTRODUCTION

A herpesvirus infection of salmonid fish in Japan was first described by Sano (1976) on an isolato from moribund kokanee salmon (*Oncorhynchus nerka*) in Towada Lake, northern part of Honshu, main land of Japan. Subsequently, in 1978, a herpesvirus was isolated from the ovarian fluid of mature masu salmon (*O. masou*) cultured in Hokkaido. This virus was named *Oncorhynchus masou* virus (OMV) (Kimura et al., 1981a). Following the discovery of OMV, many strains of herpesvirus which can be neutralized with antiserum against OMV have been isolated from cultured and wild salmonid fish in the northern part of Japan (Yoshimizu et al., 1993). Since 1988, herpesvirus infections had become a major problem in pen cultures of coho salmon (*O. kisutch*) in the Tokoku district and in pond cultures of rainbow trout (*O. mykiss*) in Hokkaido.

NERKA VIRUS IN TOWADA LAKE (NeVTA)

High mortality has been observed among the fry of kokanee salmon, land-locked *O. nerka*, from June to September of every year since 1970. The mortality reached over 80 % for the 3 month periods. The affected fish demonstrated the following signs: a darkening in body color, sluggish behavior and loss of appetite. From these moribund fish, a syncytium-forming virus was isolated in RTG-2 cells incubated at 10 C in 1972 and 1974. The virus was classified a member of herpesviridae and it was named the nerka virus in Towada lake, Akita and Aomori Prefecture (NeVTA) (Sano, 1976). NeVTA is pathogenic. It lacks oncogenicity.

MASU SALMON HERPESVIRUS ; *ONCORHYNCHUS MASOU* VIRUS (OMV)

In 1978, a herpesvirus was isolated from the ovarian fluid of an apparently normal mature masu salmon (*O.masou*), cultured in the Otobe Salmon Hatchery in Hokkaido. This virus was named as *Oncorhynchus masou* virus, from the scientific name of the host fish by Kimura et al. (1981a). The general properties of OMV were similar to those of *Herpesvirus salmonis* and NeVTA, but it differed in virion size and its optimal growth temperature. It was also distinct from *H. salmonis* with respect to its virus-induced polypeptide patterns and serological properties (Kimura and Yoshimizu, 1989). OMV was pathogenic and more significantly, oncogenic for masu salmon and several other salmonid fish (Kimura et al., 1981b). One-month-old kokanee salmon exhibited the greatest sensitivity. Masu and chum salmon also exhibited high susceptibility. Coho salmon and rainbow trout were shown to be less susceptible to OMV infection. The incidence of tumor-bearing fish approached more than 60 %. Epithelial tumors were found on 12-100 % of the surviving chum, coho and masu salmon, and rainbow trout beginning at about 4 months and persisting for at least 1 year post-infection (Yoshimizu et al., 1987). Since its discovery in 1978, at the Otobe Salmon Hatchery, OMV has been isolated from the

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ovarian fluid and neoplastic tissue of mature masu salmon collected from other places. In 1981, a similar herpesvirus was isolated from the tissues of a basal cell carcinoma that developed on the mouth part of yamame (another name for masu salmon) cultured at Koide Branch, Niigata Prefectural Inland Fisheries Experimental Station. This virus was named yamame tumor virus (YTV) (Sano et al., 1983). Serologically, NeVTA, OMV and YTV were confirmed as being the same virus by Sung et al. (1996). Six representative OMV strains, which were isolated from ovarian fluid and tumor tissue of cultured as well as wild masu salmon in Hokkaido and Aomori Prefecture, were also confirmed as being the same virus by DNA restriction endonuclease cleavage analysis by Gou et al. (1991a). From the results of the comparison of the DNA homologies, OMV and YTV were classified as same virus and NeVTA was classified as being similar yet distinct from these 2 viruses (Eaton et al., 1991).

COHO SALMON HERPESVIRUS

Since 1988, herpesvirus has been isolated from the liver, kidney, and developing neoplasms in pond and pen-cultured coho salmon (Kimura and Yoshimizu, 1989). Affected fish showed the following disease signs: ulcers on their skin, white spots on their liver, and neoplastic tissues around their mouth part or body surface. Coho salmon culture was economically damaged by this disease. The herpesviruses isolated from coho salmon were tentatively named as coho salmon tumor virus (CSTV), *O. kisutch* virus (OKV) by Horiuchi et al. (1989), coho salmon tumor virus (COTV) by Kimura and Yoshimizu (1991) and coho salmon herpesvirus (CHV) by Kumagai et al. (1994). All of these viruses were neutralized by anti-OMV or NeVTA rabbit serum, and the oncogenicity of CSTV, OKV and COTV was confirmed by artificial infection. In addition, restriction endonuclease profiles of CSTV were same as those of NeVTA and YTV (Igari et al., 1991). CHV showed strong pathogenicity to coho salmon (Kumagai et al., 1994).

RAINBOW TROUT HERPESVIRUS

Since 1992, massive mortality has occurred among one-year-old rainbow trout in pond cultures. The diseased fish exhibited almost no external signs. Some fish did manifest ulcerative lesions on their skin. Internally, intestinal hemorrhage and white spots on the liver were observed. No bacterial, fungal or parasitic agents were found and the herpesvirus was isolated from the kidney, liver, and ulcerative skin tissues. The rainbow trout culture industry experienced serious economic losses due to this disease, since rainbow trout of marketable size were affected and died. This herpesvirus was tentatively named rainbow trout kidney herpesvirus (RKV) by Suzuki et al. (1993). These viruses were neutralized with anti-OMV rabbit serum (Sung et al., 1996) and their main characteristics were the same as OMV. RKV showed strong pathogenicity to marketable-size rainbow trout and masu salmon (Suzuki et al., 1993).

ROOTS OF OMV

Since 1978 to 1996, 24,973 females of 6 species of mature salmonid fish were collected to survey the incidence of this virus in Hokkaido and the northern part of Honshu. Herpesvirus was isolated from masu salmon at all the investigated sites with the exception of one hatchery. All of the isolates were neutralized with anti-OMV rabbit serum (Yoshimizu et al., 1993). Based on our epizootiological study, the roots of OMV in Japan was assumed to be along the Japan Sea coast of Hokkaido and presumed original host species was masu salmon. In 1960's, eggs of masu salmon were collected from the rivers of Japan Sea coast of Hokkaido, and transported to Honshu Island, main land of Japan. With the unrestricted fish movement, the virus spread to several places in Honshu where the first cancer disease of masu salmon was observed, and also in Hokkaido where OMV could already be detected. Subsequently, coho salmon and rainbow trout were cultured in the same water systems where masu salmon was cultured. Coho salmon might be infected with OMV at fry stage in fresh water because when we found the tumor tissue around the mouth of pen cultured coho salmon, the hatchery from where coho salmon was transplanted to pen had a history of OMV infection (Kimura and Yoshimizu, 1991).

DIAGNOSIS

Detection of OMV in carrier fish is difficult but the virus replicates and appears into ovarian fluid at mature stage. For the purpose of virological survey of mature salmonid, ovarian fluid is collected by the method described by Yoshimizu at al. (1985), with the addition of the same volume of antibiotic solution and reacted at 5 C, overnight. In the case of the tumor tissue, tissue is cut and disinfected with iodophore (50 ppm, 15 min), then washed with Hanks's BSS. Tumor tissue must be prepared for the primary culture or co-culture with RTG-2 cells. After the one transplantation of primary culture cells, the virus inspection of the culture medium should be carried out. In the laboratory, rabbit serum or monoclonal antibody against OMV was used for fluorescent antibody test (Hayashi et al., 1993) and also DNA probe was used for detection of an asymptomatic or diseased fish (Gou et al., 1991b).

CONTROL OF OMV INFECTION

OMV is sensitive to ultraviolet irradiation, ozone or iodophore treatment (Kimura and Yoshimizu, 1989). Since 1983, we strongly recommended the inspection of the ovarian fluid from matured fish and the disinfection of collected eggs in almost hatcheries in Hokkaido with iodine at the early eyed stage as a control strategy. Currently OMV is no longer detected in most of the hatcheries in this area. Nowadays,

all eggs and facilities had been disinfected by iodophore just after fertilization and again eggs were disinfected at the early eyed stage. As a result, OMV cannot be isolated in most of the hatcheries in this area, and could avoided the outbreak of OMV infection (Yoshimizu et al., 1993).

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