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Indonesian Experience on the Outbreak of Koi Herpesvirus in Koi and Carp (*Cyprinus carpio*)

Agus SUNARTO[1], Akhmad RUKYANI[2] and Toshiaki ITAMI[3]

[1]: *Fish Health Research Laboratory, Jl. Ragunan 20, Jakarta 12540, INDONESIA*
[2]: *Directorate of Fish Health and Environment, Jl. Harsono RM 3, Jakarta, INDONESIA*
[3]: *Miyazaki University, Gakuen Kibana-dai Nishi 1-1, Miyazaki 889-2192, JAPAN*

Correspondence, e-mail: agussunarto@hotmail.com

Abstract

Koi Herpes Virus (KHV) is a new emerging disease known to cause gill and skin damage in koi and carp (*Cyprinus carpio*). The disease suspected to have been introduced into Indonesia through importation of koi from Hongkong. It is currently occurring in Indonesia since March 2002 starting in the area of Blitar in East Java. Since then it has been spreading rapidly throughout Java Island, Bali, southern part of Sumatra, East Kalimantan and Central Sulawesi. The disease cause very high mortality (80-95%) to both koi and common carp with estimated losses of more than 150 billion rupiahs (equal to US$15 M) as of December 2003. To prevent the spread of the outbreaks to other islands, the Government of Indonesia issued Ministerial Degrees that declared Java and Bali Islands as an isolated area of the disease and moving koi and carp from Java and Bali Islands to other islands are strictly prohibited or should follow quarantine check for KHV. In addition, importing koi and common carp is permitted only from free KHV countries. A Task Force consisted of international, national and local experts were organized to conduct emergency assessment of the disease situation through epidemiological investigations, field observations and laboratory examinations. Information on KHV was disseminated widely across the country with the use of TV, radio, newspaper, posters, pamphlets and technical guideline. In farm level, biosecurity concept was applied to reduce the risk of KHV outbreak. The implementations of government regulations pertaining the outbreak and key components of biosecurity are discussed in this paper.

Key words: Koi herpesvirus (KHV), Outbreak, Control, Indonesia

Introduction

Koi carp (*Cyprinus carpio*) is an economically important freshwater ornamental fish cultured in Indonesia, while common carp (*Cyprinus carpio*) is the main freshwater fish species in the country. Annual production of cultured common carp in last five was as follows: 56,546 MT (1998), 57,278 MT (1999),75,322 MT (2000), 76,475 MT (2001) and 83,885 MT (2002) (DGA, 2003). Fifty percent of this annual production is con-tributed by West Java. There are three type of common carp culture systems, i.e. floating netcages culture in the lake or reservoir, running water (raceway) in the river or stream and earthen ponds. In addition to the cultured common carp, the fish are also found in wild habitats such as rivers, lakes and reservoirs.

Koi herpesvirus (KHV) is a new emerging disease known to cause gill and skin damage in koi and carp (*Cyprinus carpio*). The disease was first recognized in Israel and USA (Hedrick *et al.*, 2000). Since then it has been reported in Europe including Germany (Hoffman *et al*., 2002) and United Kingdom (Way *et al*., 2002). In Asia, KHV has been reported in Indonesia (Sunarto *et al*.,

2002), Japan (Sano *et al.*, 2004) and Taiwan (Tu *et al.*, 2004).

This paper describes the status of KHV infection in Indonesia and the experience of the country dealing with this disease outbreak. The implementation of the government regulations pertaining prevention of KHV outbreak and key components of managing the disease in farm level through biosecurity concept are also discussed in this paper.

History

The history of KHV in Indonesia including the first 3-episodes of the outbreak was chronologically described by Sunarto *et al*. (2002). The first episode of mass mortalities of cultured koi (*Cyprinus carpio*) was recorded in March 2002 in Blitar, East Java. It occurred after heavy rains among new fishes introduced from Surabaya, the capital city of East Java. The fish were imported from China through Hongkong in December 2001 and January 2002. Blitar is well known as the centre for koi production in the country. The koi including the infected one were distributed over the country, with to Central Java, West Java and Jakarta as the main market.

The second disease outbreak occurred in cultured common carp (*Cyprinus carpio*) during the end of April 2002 in Subang regency, West Java. The gross signs of the diseased common carp were extremely similar with that observed previously in koi carp.

Subang is one of the production centres of common carp in West Java. Since then the outbreaks spread to neighbouring regencies mainly through fish movements.

The third episode of the outbreak occurred in end of May to early of June 2002 in cultured common carp in floating netcage at Cirata Reservoir, West Java. Weeks before the outbreak, farmers introduced common carp from Subang region due to the low price of fish.

The fourth episode of the outbreak occurred in February 2003. The outbreak affected cultured common carp in Lubuk Lingau regency, South Sumatera. The gross signs of the diseased common carp were extremely similar with that observed previously in koi and carp in Java islands. Common carp farms at Lubuk Lingau were infected with the disease coming from Cirata Reservoir, West Java through fish transfer by traders. The outbreak then spread to neighbouring district and province including Bengkulu in the south and Jambi in the west.

Geographical Distribution

A survey of KHV was conducted in April 2003 as part of FAO's Technical Cooperation Project entitled Health Management in Freshwater Aquaculture (Cameron, 2003; Rukyani, 2003). The main objectives of the survey were to determine the extent and the distribution of the population at risk against KHV, the current distribution of the disease and extent of the disease.

In order to achieve these objectives and meet the criteria listed above, a rapid survey at district (*kabupaten*) level as a unit of interest was conducted. The survey was at all districts in the country (353 districts). A printed questionnaire, which is submitted to the district fisheries services, was used to collect data. The questionnaire was pre-printed with the name of each district and province, as well as the district code, to simplify the data entry.

The results showed that KHV has infected most of district in Java islands, Bali, southern part of Sumatera, East Kalimantan and Central Sulawesi. The geographic distribution of KHV in Indonesia as of February 2003 was illustrated in Fig. 1.

Fig 1. Geographical distribution of KHV in Indonesia. Red colour indicated KHV infected areas.

Epizootiology

Host. Morbidity and mortality due to the virus were restricted to koi and common carp (*Cyprinus carpio*) populations.

Carrier. It is not known yet whether any fish species other than *Cyprinus carpio* harbour the virus and act as carriers of KHV.

Mortality. The disease cause very high mortality (80-95%) to both koi and common carp.

Mode of spread and transmission. The disease transmits from diseased fish to healthy fish occur through direct contact, infected tissues or dead fish and contaminated water and equipments. Local spread of the disease occurs through contaminated water source and irresponsible movement of infected fish. Long distance spread of the disease mainly occurs through irresponsible movement of infected common carp and unintentional spread through koi show.

Clinical sign. The infected fish were lethargic, showed loss of balance and gasped for air. Common gross sign including sloughing off the epithelium with loss of mucus and rough appearance of the skin or showed a blister-like lesion on the skin, haemorrhages of operculum, fins, tail and abdomen, and severe gill damages (Fig. 2).

Fig 2. Clinical signs of KHV-infected carp. Note the gills damage.

Environmental factors. Most of the outbreaks occurred when infected fish introduced to non-infected fish/farm/ area. The heavy rain prior to the initial outbreak made us to consider the possibility of an environmental triggering factor, such as water temperature. Another environmental factor that may trigger the outbreak is low water quality. However, research was needed to elucidate the environmental and other factors that trigger the outbreak.

Diagnostic Technique

Diagnostic methods against KHV was established based on standard of FAO/NACA/OIE (Bondad-Reantaso *et al*, 2001) i.e. environmental observation and clinical sign (diagnostic level 1), histo-pathology changes (level 2) and molecular biology (level 3). In order to minimise mis-diagnosis of KHV in farm level (diagnostic level 1), a 'case definition' was established, i.e. high mortality of koi or common carp (*Cyprinus carpio*) within 7 days, in which the fish shows gill damage, with or without any other clinical signs.

Diseased fishes showed consistent histopathologycal findings including

intranuclear amphophilic inclusion bodies with peripheral chromatin margination were observed within the gill's epithelium. Similar inclusions were also observed within the kidney tubular epithelium (diagnostic level 2).

PCR detection (diagnostic level 3) of KHV was carried out using specific primers set developed by Gray *et al*. (2002) and Gilad *et al*. (2002).

However, since histopathological changes due to KHV infection were not obviously observed in most of the diseased fish, histopathological changes was hardly used for diagnostic (level 2). Currently, the diagnosis of KHV in Indonesia was based on 'case definition' (diagnostic level 1) and PCR detection (level 3).

Public Health

The fact that some of the diseased fish showed blister-like lesion and the word of 'herpes', which is associated with herpesvirus in human, has increased concern of consequences of consuming diseased fish. There is however, no scientific evidence that KHV is a zoonotic disease.

Socio-Economics Impact

The first report regarding the economic losses due to the outbreak was made by the head of the Association of Ornamental Fish Culture of Blitar regency, East Java. They reported that in Blitar alone, the outbreak destroyed high quality koi carp belong to 5,000 fish farmers with economic losses more than Rp. 5 billions (US$ 0.5 millions) within the first 3 months period of the outbreak. As of July 2002, the NACA's Task Force estimated that the loss revenue of the sector and the socio-economic impact to the rural farming communities was in the region of US$ 5 millions.

As the outbreaks continued and spreading to new areas, the socio-economic impact due to the outbreaks was escalated. Directorate of Fish Health and environment (DFHE) estimated that as of December 2002 and 2003, losses due to KHV were US$10 million and US$15 million, respectively.

Control Measures

There are no known treatments for fish infected with KHV, however, a number of preventive measures have been taken by the Government of Indonesia to reduce the spread of the disease in national level.

Soon after the first outbreak in March 2002, the Directorate General of Aquaculture (DGA) issued circulation letter pertaining the occurrence of the outbreak and prohibition of movement of infected fish from infected area to non-infected area. With regard to KHV outbreak, 2 Ministerial Decrees have been issued. Ministerial Decree No. 28, June 2002 followed by Ministerial Decree No. 40, October 2002 were issued in order to protect the country from the introduction of the disease, to prevent wider spread of KHV and to minimise economic losses on koi and common carp culture. The Degrees declared Java and Bali Islands as an isolated area of the disease and moving koi and carp from Java and Bali Islands to other islands are strictly prohibited or should follow quarantine check for KHV. In addition, importing koi and common carp is permitted only from free KHV countries.

However, the circumstances make the application of the Decree No. 40/2002 less effective, because trucks with live fish often cross the strait without reporting to the quarantine checkpoint office. The application of Decrees is relatively ineffective as the disease leak to South Sumatra in February 2003. The spread of KHV disease to the whole of Sumatra is just a matter of time unless there is other policy to stop the infected live fish movement within Sumatra islands. Therefore, the Governor or provincial authorities of uninfected regions should be encouraged to regulate the

transportation of live carp from Java to their provinces (Prayitno, 2002).

Besides issuing rule and regulation, the government had also quick response to the outbreak including organizing local disease task force, reporting the outbreak to the OIE (Rukyani, 2002) and seeking assistance from international agencies. The last has lead to the formation of task force from Network of Aquaculture Centre in Asia-Pacific (NACA's Task Force) and project from a Technical Cooperation Programme from Food and Agriculture Organisation (FAO-TCP project).

The NACA's Task Force consisted of international, national and local experts were organized to conduct emergency assessment of the disease situation through epidemiological investigations, field observations and laboratory examinations. Information on KHV was disseminated widely across the country with the use of TV, radios, newspapers, posters, pamphlets and technical guidelines.

Under FAO-TCP projects, various issue regarding policy and legislation on fish health management in Indonesia were addressed. These are include enhance national regulatory framework and development of national strategy on fish health management. Other related issues on fish health management such as strengthen diagnostic and control capability, improve surveillance, monitoring and disease reporting system, human resource development and public awareness are being addressed. A web-based information system on disease fish health management (www.ausvet.com.au/indofish) has been constructed through the project.

Soon after the outbreak, the government provides aids to affected carp farmers. These include broodstocks, disinfectant, training, dissemination of information and consultancies. A website (www.ditkeskanling.go.id) was also established to provide information on fish health management including KHV outbreak.

As there are no treatments for KHV, attempt to control the outbreak in farm level is focused on the prevention of getting infected with the virus and subsequently reducing the mortality once the farm is infected with the disease.

Biosecurity. Most outbreaks occurred after the introduction of new fish from infected area or getting infected through contaminated equipment and water source. Therefore, biosecurity concept may be applied to prevent or reduce the possible KHV infection. For non-infected farm, it is highly recommended to use only KHV-free seed and broodstock and to avoid introduction of new fish, particularly from infected area. If introduction of new fish is unavoidable, it is recommended that all new fish be quarantined for at least 2 weeks, together with sentinel fish at permissive water temperature between 18-28^{o}C.

For farm/area where KHV is presently endemic, eradication of KHV from the farm should be done prior stocking with KHV-free stocks. It should include removal of all fish (particularly all susceptible species) from ponds, reservoirs, and water canal prior to re-stocking, drying out and liming the ponds and disinfections of contaminated equipment.

Once the virus has been eradicated from a site, it is important to prevent its re-introduction. It is likely that infection is spread by affected fish, as well as by contaminated water and equipment. Accordingly, the following measures should be considered: seed and broodstock should be obtained from KHV-free area, all wild carps must be rigorously excluded from farms in endemic areas, water should be obtained only from an KHV-free sources, and equipment which may have been used at infected sites must be disinfected. However, these practices may only be effective for isolated farm such as koi farm, but not for cage culture in the lake/river and raceway culture in the river.

Good management practices. Good management practices (GMPs) should be applied in koi and carp culture. It seems that GMPs could decrease the mortality due to KHV infection. It is recommended to use only KHV-free seed and reduce stocking density. There are scattered reports that transferring diseased fish from raceway to earthen pond will decrease the mortality and prevent further losses. This practices reduced the stocking density and stable water temperature, hence provide a better environment to the diseased fish. The use of immunostimulant and vitamin C may increase non-specific immunity of fish against KHV.

It is recommended to remove dead and moribund fish from the pond, as they are a good reservoir for the virus. In order to reduce the mortality, curative measures were also applied to treat secondary infection of parasite, fungi and bacteria. Enrofloxacine (5-10 ppm) were used to treat secondary bacterial infection. Dyvon (Dichlorphos) of 1-5 ppm and Benzalkonium chloride (BKC) of one drop/100 L were used to treat Argulus and other parasite infection.

Despite of the difficulties on the control of the outbreak in common water body such as in the raceway and netcages in a reservoir/lake, GMPs and biosecurity concept seems to provide an alternative control strategy in farm level. However, further research need to be done to identify other key component of biosecurity and GMPs, which effective to control KHV outbreak.

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