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Biosecurity practices in hatcheries of high value fishes

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Abstract. The present study was conducted to know the status of biosecurity from some commercial fish hatcheries producing high value fish seeds including gulsha (*Mystus cavasius*), shing *(Heteropneustes fossilis*) and koi (*Anabas testudineus*) in Mymensingh and Jessore districts. Data was collected from 90 hatcheries of each district through questionnaire interview. Biosecurity status of hatcheries was evaluated through some previously set criteria including infrastructure, restriction on entry of visitors, use of foot bath, protective clothing, hatchery hygiene, disinfection and sanitation, record keeping, hatchery personnel's academic qualification and training. Severe lacking on some biosecurity measures were observed such as use of foot bath, restriction on visitors, record keeping system, pest control management, proper disinfection of equipment, and feed inspection. No hatchery owners were found to use any protective clothing and vaccination. Some biosecurity measures were found quite satisfactory such as good hygiene (86%), cleaning of hatchery units (100%), water quality (78%), stocking of disease free broods (77.50%) and internal quarantine procedure (80%). Hatchery owners reported some diseases in brood fishes which included gill and fin rot, abdominal distension, ulcerative hemorrhagic lesion and whitish appurtenance. Overall the biosecurity status in hatcheries was not that satisfactory. It is thus important to improve biosecurity status in fish hatcheries through updated training of hatchery personnel.
Keywords: Hatchery, Biosecurity, Gulsha, Shing, Koi

Introduction

Bangladesh has emerged as one of the leading nations in aquaculture production and currently ranked fifth among the aquaculture producing countries of the world (FAO 2022). At the beginning of aquaculture in the country, the major source of fish seed was the inland open sources rivers. However, to meet the present demand and considering future potentials, a large number of hatcheries have been established in different parts of the country. Currently, there are around 1056 hatcheries in Bangladesh of which 963 are private and 103 are run by the government (DoF 2022). During 2020-21, about 6,68,801 kg fish spawn was produced from these hatcheries while only 2152 kg fish seed were collected from natural ground (DoF 2022).

Disease incidence in hatcheries and grow-out systems is an important issue in aquaculture. Because, disease causes major financial losses in aqua farms and has a wide range of impacts throughout the aquaculture industry (Fegan and Sharif 1997). There could be many responsible sources for disease outbreaks in hatcheries, such as introducing new outsourced broodstock, contaminated equipment, birds and other animal access or cross contamination as a vector. Disease may occur into a hatchery during routine operational activities as well and can cause severe financial losses and be a serious setback for a hatchery operator (Smith 2012, Mohamed and Subasinghe 2017).

Maintaining biosecurity is very important as it can reduce the risk of disease. Biosecurity is the measures and methods adopted to secure a disease free environment in all phases of aquaculture practices. Biosecurity in aquaculture consists of practices that minimize the risk of introducing any infectious agents and spreading it within the facility and even to prevent risking other surrounding sites and susceptible species (Danner and Merrill 2006). Therefore, biosecurity practices also reduce stress to the animals, and making them less susceptible to disease.

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An important area of disease prevention and control is the use of hatchery disinfection. Routine disinfection is used to reduce the pathogen load in a facility, thereby reducing the risk of spreading an infectious organism in a single facility. In addition, cleaning and disinfection of the aquaculture facility and associated equipment between production cycles is very important and helps reduce the risk of spreading an infectious agent from one production group to the next. General security precautions need to be established for each facility to help support the activities of both disease prevention and disease control (Smith 2012).

Since treatments against aquatic animal diseases is not always effective and may cause environmental hazards; effective biosecurity is the key to proper health management and disease prevention. However, there is hardly any scientific information available regarding biosecurity status in fish hatcheries of Bangladesh. The objective of the present study was to assess the status of biosecurity in commercial fish hatcheries producing seeds of high value fish.

Materials and Methods

The study was conducted in two districts, Mymensingh and Jessore. Data was collected through questionnaire interviews with 90 commercial hatchery owners (45 from each district) producing seeds of high value fishes including gulsha, shing and koi. The questionnaire focused mainly on infrastructure facilities of hatchery, general maintenance, disinfection and sanitation, hatchery personnel, quarantine system, feeding strategy, disease problem and their preventive measures. Pre-testing of the draft questionnaire was conducted with few hatchery owners by the researcher. After making necessary modification and adjustments, a final set of questionnaire was developed in a logical sequence. The data were recorded, processed and analyzed using Microsoft Office Excel program.

Results

Hatchery types: Biosecurity status of 45 hatcheries in Mymensingh and 45 hatcheries in Jessore, produced fish seeds of gulsha (*Mystus cavasius*), shing (*Heteropneustes fossilis*) and koi *(Anabas testudinius*) were analyzed. Among the hatcheries, 13.50% hatcheries produced seeds of gulsha, shing and koi, average 77.50% produced both gulsha and shing seeds and only 9% produced seeds of only koi fish (Table I).

Table I. Types of fish hatcheries (%) in the study areas

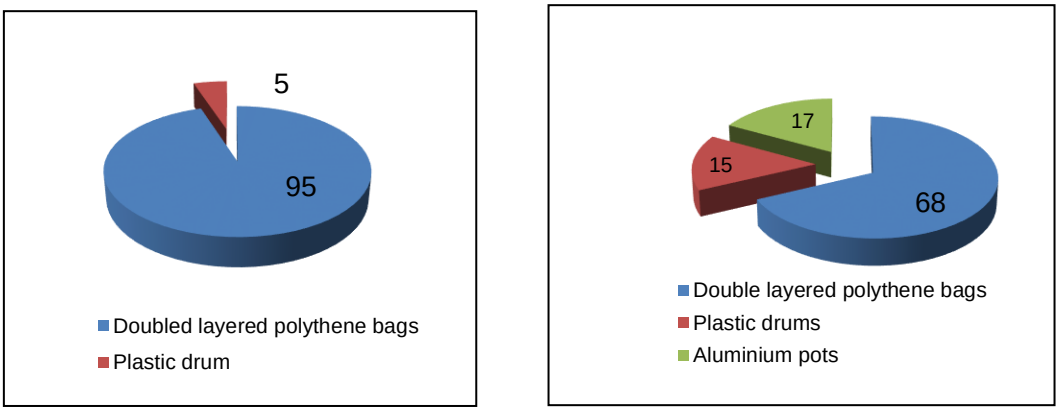
Types of hatchery	Mymensingh n=45	Jessore n=45	Mean ± SD
Gulsha, shing and koi	16.00	11.00	13.50 ± 3.535534
Gulsha and shing	73.00	82.00	77.50 ±6.363961
Only Koi	11.00	7.00	9.00 ± 2.828427

Sources of brood fish: Hatcheries in the study areas used brood from different sources. Majority of them used their own brood (62%) followed by brood from government hatcheries (21%) and other sources included Bangladesh Fisheries Research Institute (BFRI) and rivers (Table II).

Table II. Sources of brood fishes (%) used in hatcheries

Sources	Mymensingh n=45	Jessore n=45	Mean ± SD
Own hatchery	51.00	73.00	62 ± 15.55
BFRI	16.00	0.0	8 ± 11.31
Govt. hatchery and other farms	20.00	22.00	21 ± 1.41
BFRI and own hatchery	11.00	0.0	6 ± 7.77
Rivers	2.00	4.50	3 ± 1.76

Fry transportation: Clean and disinfected carriers and vehicles can reduce the risk of any pathogen introduction. In Mymensingh, majority (95%) of the hatchery owners used double layered plastic bags for fry transportation and only 5% used plastic drums for this purpose (Fig. 1). In Jessore, 68% hatcheries found to use double layered plastic bags followed by aluminum pots (17%) and drums (15%). Before carrying fry, they used to disinfect the drums, pots and polythene bags with potash and salt.



Mymensingh **Jessore**

Fig. 1. Fry transportation system (%) in the study areas.

Biosecurity status in hatcheries

Infrastructures: It was found that average 93% hatcheries had protective boundary and 86.5% had gates in their hatcheries. However, restriction of visitors and use of foot bath before entering hatchery were found very poor. Average only 12.25% had some sort of such restriction and only 4.5% hatcheries used foot bath before entering hatchery premises (Table III). Usually hatchery owners keep the new brood fish in separate tank and observe their health and disease condition for few days upon arrival. In Mymensingh, about 33% hatcheries found to have such facilities of internal quarantine practice while In Jessore area, this facilities was found quite high (42%) than Mymensingh (Table III).

Table III. Infrastructure facilities (%) of hatcheries in study area

Measures	Mymensingh n=45	Jessore n=45	Mean ± SD
Protective boundary	91.00	96.00	93 ± 3.535534
Gates	84.00	89.00	86.5 ± 3.535534
Foot bath	2.00	7.00	4.50 ±3.535534
Restriction on visitors	4.50	20.00	12.25 ± 10.96016
Internal quarantine	33.00	42.00	37.5 ± 6.363961

Source of water: On average, majority of the hatcheries used submersible pump (78.50%) in both areas to fulfill the water requirement of their hatcheries. Besides tube well water and other sources were also used showing in Table IV.

Table IV. Water sources (%) used for hatcheries in study regions

Water source	Mymensingh n=45	Jessore n=45	Mean ± SD
Submersible pumps	84.00	73.00	78.50 ± 7.778571
Tube well water	9.00	11.00	10 ± 1.414214
Others	7.00	16.00	11.50 ± 6.36396

General maintenance: An average of 77.5% hatcheries tried to stock disease free brood (Fig. 2). A good number (78%) of hatcheries were found to monitor water quality parameters in their hatcheries quite regularly. Diseases monitoring practices were also seen very satisfactory in hatcheries since average 92% hatcheries did that routinely. However, record keeping and regular staff meeting were noticed very poor. Average 24.5% hatcheries maintained proper records and only 8.75% hatcheries arranged regular staff meeting (Fig. 2). In the study areas, no hatchery owners were found to use vaccines for disease prevention.

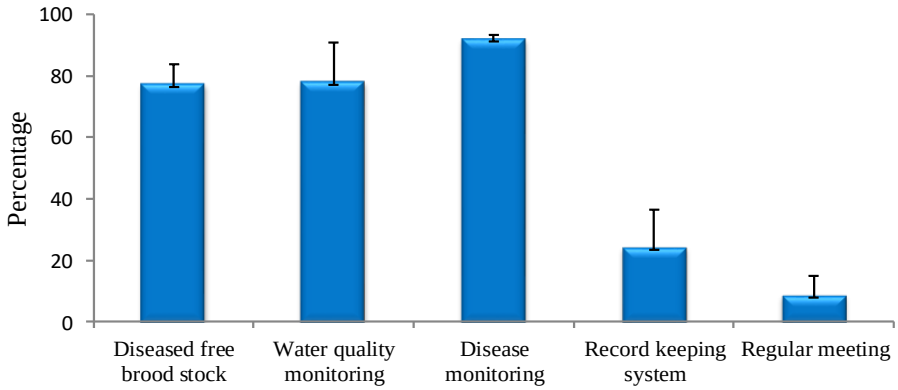


Fig. 2. General maintainance facilities (%) of hatcheries in the study areas.

Sanitation and disinfection: Average 59% hatcheries were found to clean their hatchery units before starting operation. In Mymensingh, it was noticed that 89% hatcheries disinfected tanks and nets before using in hatchery premises while in Jessore, the rate was 91% (Table V). All the

hatcheries in both the study areas moved equipment frequently. They used the same nets and equipments in different hatchery units. Pest management was found very poor (16.50%) in hatcheries. However, majority of the hatcheries both in Mymensingh (93%) and Jessore (96%) used to remove dead and moribund fish immediately. Different types of disinfectants were used routinely in hatcheries. Potassium permanganate, agricultural lime, combination of potash+lime, copper sulfate and methylene blue were used by the most of the hatcheries.

Table V. Sanitation measures (%) of hatcheries in the study area

Measures	Mymensingh n=45	Jessore n=45	Mean ± SD
Cleaning hatchery units	57.00	61.00	59 ± 2.828427
Tank and net disinfection	89.00	91.00	90 ± 1.414214
Movement of equipment	100.00	100.00	100 ± 0
Pest management	11.00	22.00	16.50 ± 7.778175
Removal of diseased fish	93.00	96.00	94.50 ± 2.12132

Hatchery personnel: In the both study areas, academic/ literacy qualification of hatchery personnel was poor and on average only 21% staff had some sort of education background. Staff training related to hatchery operation was also very poor (5.5%). No hatchery personnel were found to use any protective clothing during hatchery operation (Table VI).

Table VI. Status of hatchery personnel (%) in hatcheries of the study areas

Measures	Mymensingh n=45	Jessore n=45	Mean ± SD
Education	19.00	23.00	21 ± 828427
Training	7.00	3.00	5.5 ± 2.12132
Use of protective clothing	0.00	0.00	0.00

Feed management: Better storage condition increases the longevity of feed. In the present study, the feed storage condition was found very poor and average only 10% hatcheries had quite good feed storage condition. Also, regular inspection of feed quality was not a common practice and average 5.4% hatcheries used to follow this practice (Table VII).

Table VII. Feed managements (%) of different hatcheries in both study area

Measures	Mymensingh, n = 45	Jessore, n = 45	Mean ± Sd
Feed inspection	9.00	2.00	5.5 ± 4.969761
Good storage condition	13.00	7.00	10 ± 4.242641

Diseases in hatcheries

Diseases in brood: A number of diseases of brood fishes were reported by the hatchery owners of the both study areas. The most common and frequently occurred disease was gill and fin rot (78%). Other conditions were also noticed including hemorrhagic ulceration, abdominal distension and whitish appearance (Fig. 3).

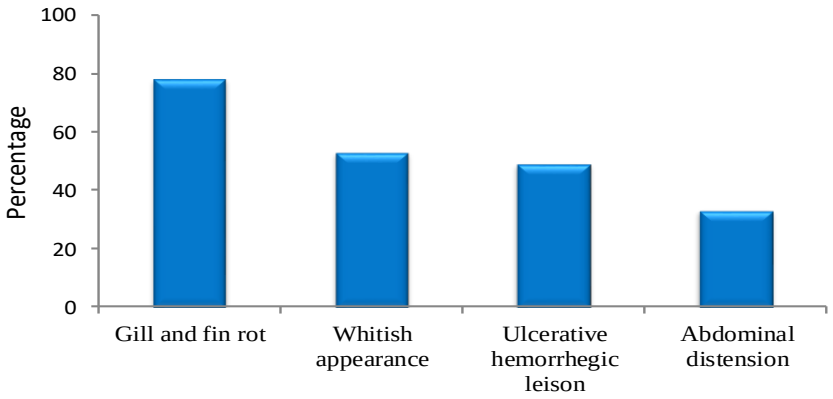


Fig. 3. Diseases of brood (%) in hatcheries of the study area.

Diseases of spawn and fry: Hatchery operators in the study areas reported different disease and health problems of fish hatchlings and fries. The major problems included superficial cotton wool fungal infection like lesion in fertilized eggs (55.5%), spiral movement (30.5%) and white spot inside the yolk sac (20%). Other conditions included spinal deformities, loss of slime, enlarge head and blindness (Fig. 4).

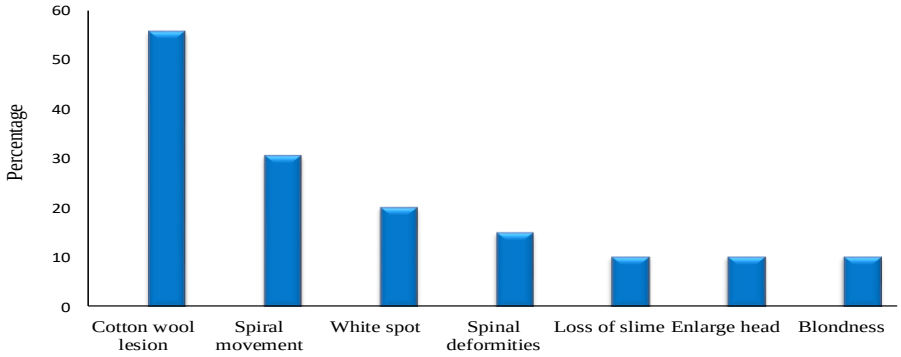


Fig. 4. Diseases of spawn and fry (%) in hatcheries of the study area.

Discussion

The present study examined the status of biosecurity in some selected high value commercial fish hatcheries of Mymensingh and Jessore. While aquaculture has made rapid advances in the past few years, biosecurity status of hatcheries, fish diagnostics, disease prevention and disease control measures lag significantly behind. The primary goal of a biosecurity program in aquaculture is to prevent the introduction of any infectious organism into an aquaculture facility. It was found that,

now-a-days many commercial hatcheries of high value fish were established in both study areas. For those hatcheries, farmers collect brood fish from various sources. Proper care of brood stock is essential for good production of eggs, larvae and juveniles. It was found in the present study that the hatchery owners did not maintain sufficient brood stock. Though the hatchery operators used healthy and disease free broods they did not maintain proper biosecurity measures.

For producing biosecured fish seed, infrastructure of a hatchery is quite important. Hatchery would situated in such as place that have sufficient light, air and all facilities of hatchery operations including quarantine and acclimatization facilities, breeding and hatching circular tank, overhead tank with oxygen mixing facility, separate hatchery building, office room, staff and store room, protective boundary, gates, foot bath. Most of the hatchery owners in both areas maintain protective boundary and gates but there is a severe lack of foot bath system, which is necessary part of every hatchery and maintains biosecurity status of a hatchery. If there is a footbath system workers and visitors can wash their feet by dipping in the disinfectants such as potassium permanganate kept there. As a result risks of pathogens entrance lowers to an extent. Only 4.5% hatcheries had foot bath system in average. For lack of proper knowledge the owners did not understand the importance of construction of foot baths.

An important method of disease prevention is providing hatcheries with pathogen free water source. In the present study, underground water lifted through submersible pump was the primary water source of almost all hatcheries though these are susceptible to risks associated with dissolved gases (Delabbio *et al*. 2004). A hatchery's water supply is an important asset that has a major influence on animal health. Disease transmission risks will depend on the nature of the water source, presence of host animals in that water source and the proximity of other farms that may discharge into the water source. A good water source increases biosecurity of a hatchery. Hatchery owners mainly used submersible pumps for water source. Besides they also used tube well water and water from rivers or other water bodies like *beel* and ponds situated near. Submersible pump was used more in Mymensingh than Jessore as Jessore is a coastal area and its water is little salty. However, in the present study the majority of hatcheries measured water temperature, dissolved oxygen levels. and pH quite regular basis. Monitoring of water quality is also crucial. The hatchery operators of both areas monitor water quality quite regularly.

Disease monitoring is one of the most important biosecurity measures. Hatchery owners in both areas monitor fish and spawn for any diseases quite regularly and its rate is quite satisfactory. However, in the present study, the reporting of diseases by owners was very low which might be due to the lack their awareness about fish disease and also lack of reporting places or diagnostic laboratory.

Record keeping is paramount to the success of any biosecurity program because it can provides accurate historical information about the health status, weight gains, feed consumption, vaccinations or treatments, and management practices of the facility. But record keeping was found not common for the hatchery operators in study regions. They do not give much emphasis on keeping their hatchery records. In Mymensingh the rate was 16% whereas Jessore had its double, about 33%. The maximum of the hatchery owners maintained their hatchery hygine regularly. They disinfect equipment quite regularly. Post (1987) mentioned that fish pathogens can be transferred from holding unit to holding unit via the fish and rearing waters, and also on shared equipment and by personnel. Therefore, disinfection of materials, hands and footwear to prevent transfer of disease pathogens is a commonly used biosecurity measure in farming enterprises (Torgersen and Hastein 1995). It is important to know which disinfectant to use, its potency over time and the length of time needed to immerse materials, in order to achieve effective reduction in the microbiological load (Amass *et al.* 2000). Hatchery owners used potassium per manganate, methylene blue, lime and copper sulphate as disinfectant.

In the present study, though some hatchery owners keep the newly collected brood in separate tanks they actually did not maintain proper quarantine procedure. The time interval required for a quarantine period can vary, but will generally take between 5-7 days. During this time, the fish can be closely monitored for clinical signs of disease, sampled for diagnostic health techniques, and treated if there is any disease. In both study areas the percentage of quarantine is very low.

In the present study, no hatchery owners were found to use any vaccine to their brood fish. Use of vaccines does not prevent the introduction of pathogens. Vaccination of fish against a certain pathogen reduces the infectious load of the pathogen within a population and there lime reduces infection pressure on a population (Delabbio 2004). This was obvious because currently only few vaccines are available against fish disease most of which are for salmon, trout, and Catfish. This study identified some diseases in brood fish in hatcheries like gill and fin rot, hemorrhagic ulceration and whitish appearance on external surface etc. Similar conditions were also reported by some other workers (Faruk *et al.* 2004, DoF 2002, Mazid 2001, BFRI 1999).

Most of the hatchery owners reported gill and fin rot as a major problem in both study areas which the farmers could easily recognize. This disease is caused by gram negative bacteria like *Aeromonas* sp, *Pseudomonas fluorescens* and *Vibrio* sp. Typically, this disease starts around the edges of the fin and gradually destroys more tissues until it reaches the bases of fins. About 93% hatchery of both study areas were affected with this disease. Besides, red ulcer in gulsha was another disease that was prevalent in Jessore than Mymensingh. Peter (1999) reported that the biggest cause of fin rot is bacterial overgrowth. Overfeeding fish can contribute to poor water quality and overcrowding can cause stress and lead to higher risk of diseases. Clinical signs of fin rot inflamed patches on the fins, faded color of the fins and fraying of the fin or tail.

This study compared the biosecurity status of commercial hatcheries between Mymensingh and Jessore. In Bangladesh hatchery technology started in Jessore first. The biosecurity status of Mymensingh and Jessore was quite similar. Still the hatcheries in Jessore were more developed than Mymensingh in terms of biosecurity. The workers good maintained sanitary measures and kept clean their hatcheries. They also had more educational qualifications and training about biosecurity than the workers in Mymensingh. From the study, it can be said that biosecurity of the hatcheries in both areas should be more developed to get healthy and disease free fish. In conclusion, the present study highlighted present status of biosecurity in commercial fish hatcheries. In order to ensure quality seed for aquaculture, it is recommended that emphasis should be given on biosecurity of fish hatcheries. Thus good quality and diseased free seeds can be produced in the commercial hatcheries.

Literature Cited

Amass, S. F., B.D. Vyverberg, D. Ragland, C. Dowell, C. Anderson, J. Slover and D. Beaudry, 2000. Evaluating the efficacy of boot baths in biosecurity protocols. *Swine Health and Production*, 8: 169-173.

BFRI, 1999. Fish diseases: prevention and control. Bangladesh Fisheries Research Institute. 2nd edition. Circular leaflet no 6. 7p.

Danner, G.R., and P. Merrill, 2006. In Aquaculture Biosecurity: Prevention, Control, and Eradication of Aquatic Animal Disease. Wiley-Blackwell. 91−128.

Delabbio, J., 2004. An assessment of biosecurity utilization in the recirculation sector of finfish aquaculture in the United States and Canada. *Aquaculture*, 242: 165-179.

DoF, 2022. National Fish Week 2022 Compendium 2022. Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 160p.

DoF, 2002. Fish fortnight compendium. Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 136p.

FAO. 2022. The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome, FAO. https://doi.org/10.4060/cc0461en

Faruk, M.A.R., M.M.R. Sarker, M.J. Alam and M.B. Kabir, 2004. Status of fish disease and health management practices in rural freshwater aquaculture of Bangladesh. *Pakistani J. Biol. Sci.*, 7: 2092-2098.

Fegan, D.F., and M. Sharif, 1997. Coping with Disease in Aquaculture. In: Sustainable Aquaculture. Published by INFOFISH, Malaysia. 140-149.

Mazid, M.A., 2001. Fish Disease and Prevention. Bangladesh Fisheries Research Institute, Mymensingh. 36p.

Mohamed Din, M.S., R. Subasinghe, 2017. Basic biosecurity manual for tilapia hatchery technicians in Bangladesh. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Manual: FISH-2017-10

Post, E., 1987. Fish Health. T.F.H. Publications, Inc., Neptune City, New Jersey.

Smith, S.A., 2012. Biosecurity and Fish Health Monitoring for Aquaculture Facilities. www.atlantech.ca/public/articles/Biosecurity 3.

Torgersen, Y. and T. Hastein, 1995. Disinfection in aquaculture. *Review of Scientific Paper*, 14: 419-434.

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