FUNGAL DISEASES

Fungal agents causes diseases and economic losses occur in different development stages (egg, larvae, fry and adult) in fishs. Fungal disease usually develop with or after other diseases (bacterial, viral, parasitic) and change course of other diseases. Even if there are fungal agents in the water, if the fish healty, that is, if there is no lesion on the skin, fin and gill , addition to if the mucoid layer of the skin is intact, fungal infections do not develop in fish.

SAPROLEGNIOSIS (WATER MOLD INFECTION / WMI /, WINTER KILL, OOMYCETE INFECTION)

It is the most common external fungal disease in freshwater and salt water fishs and fish eggs. The name of the fungi responsible for the disease are *Saprolegnia parasitica and S. invodes*, and the agents settle on the skin, fin, gill, around of mouth, head region and surface of eggs. This disease occurs in fish that live in warm and cold water.

Virtually every freshwater fish is probably susceptible to at least one species, and water molds are classical oppurtunists that normally feed saprophytically on dead organic matter.

There is increasing evidence that these infections in fish are associatied with immunosupression. Outbreaks often occur after a drop in temperatur or when temperatures are near the physiological low end for a particular fish species. Many oomycetes are more active in the cooler months of the year. When fish are exposed to acute confinement stress, their skin can actually slough off and this severe skin loss makes them much more susceptible to water mold infection (or fungal infection) .

The excessive use of hormone (corticosteroid and androgen) cause a decrease of mucus cells count in the skin, which is turn reduces the resistance of the skin. In addition, the excessive use of hormon leads to a decrease of Vit. C in fish.

When saprolegniosis affects fish during very cold temperatures it is colled winter kill. The disease occurs when pond temperature drop below 15 ° C.

The disease may be caused by immunosuppression because of the rapid temperature drop, possibly in combination with chronically high ammnonia levels or exposure to some environment stress in the prior summer / fall.

Transmission of disease ; the water fungi are ubiquitous saprophytes in soil (or sediment and mud) and water. Most transmission is probably by motile zoospores. The zoospores allows dissemination to distant sites. It is important to relazie that most fish infections are probably acquired from in animate source (i.e. , water molds sporulating on dead organic mater). There is asexual reproduction. If the infection begins in the skin, micells develop in the epidermis, but , if the zoospores have been taken by oral route, micells firstly develop in the digestive system and then reach the muscle and skin surface.

Pathology and clinical signs :

The fist clinical sign is a dermatomycosis. Typical infection present as a relatively superficial, cottony growth on the skin or gills. The first lesions begin on the surface of skin such as focal and small lesions are not realize, and then, the lesions expand and the micellia grow in the skin and gills. If the disease progresses, the lesions grow gradually and begin to spread throughouh the body. The lesions progress from epidermis to dermis and from there to the muscle layer. The epidermis layer is destroyed and shed, and then erosion and ulcers develop. The affected fish, the colour of skin are turned dark gray.

As clinical apparence, the lesions consisting of gray-white foci due to fungal micells on the skin and cottony-wool structures extending out of the body are noticeble. Newly formed lesions are white due to presence of the micellia , with them, the lesions often become colored red, brown, or green because of the trapping of sediment, alg, or debris in the micellia mat.

Although the micellia grow rapidly over the skin's surface , the infection rarely penetrate beyond the superficial muscle layers, and the micellia cause necrosis in tissue. If the micelia cover 30-40 % of the body, the treatment may not result.

Sometimes, the infection spread from gills to pharynx ad eosaphagus, and then the disease may be observed in liver, spleen kindey, brain, eyes, and swim bladder. Affected fishs are exhibited depression, anorexia, weight loss and loss of balance.

The micelia are observed in the abdominal region of fish in the infection originating from the digestive system.

Oomycetes are important pathogen of fish eggs, and infections most often begin in unfertilized or otherwise nonviable eggs. Once establishment they can rapidly spread to healthy eggs, eventually resulting in complete loss of the brood. Affected eggs are opaque. The eggs covered the micelia, in which case there is no turning back.

Diagnosis :

Observation of a cottony, proliferative growth on the skin and gills should alert the clinical to a possible diagnosis of saprolegniosis. Some other pathogens (e.g. *Flavobacterium*, *Epistly*) can cause grossly similar lesions but are easily differantiated microscopically.

Scraping preparations taken from the skin, fins and gills are examinated and the definitive diagnosis is made. Avoid skin damage and predisposing stresses. There is usually limited success in treatment. The measures to be taken in hatcheries prevent economic loss in fish farms.

1) dead or unfertilized eggs are cleaned

2) water temperatuer must be optimum and stable

3) disease fish should be not kept in the pond

4) care and nutrition should be quality

5) the skin integrity must be complete

BRANCHIOMYCOSIS (GILL ROT DISEASE)

Brachiomycosis is afungal disease that has caused acute, often high mortality in freswater fish. There are two species. The disease is caused by the fungi *Brachiomyces sanguinis and B . demigrans*. Both species of fungi are found in fish suffering from an environmental stress , such as low pH (5.8-6.5), low dissolved oxygen, or high alg bloom. The agents grow at temperatures between 14-35 ° C but grow best between 25-32 ° C.

The main sources of infection are the fungal spores carried in the water and detritus on pond bottom. Contamiantion occurs when the spores in the water enter through the gills. The agents settles and germinate and occur hypae.

Pathology and clinical signs :

Although the pathology of both species is similar to each other*, B. demigrans* is located in the gills and blood vessels, *B. sanguinis* is located in the flaments of gills and blood vessels. *Branchiomyces demigrans* reproduces outwards by destroying gill tissue, but *B. sanguinis* develops only in blood vessels and no reproduce outwards.

The gills are destroyed, and the difficulty respiration is obvious. The disease increases in the summer in temperate climates, morbility 100 %, mortality 50 %. The course of the disease is fast in the crowding ponds.

Affected fihs are exhibited difficulty of respiration, depression, anorexia, unwil ligness movement, stagnation , not taking feed. The desire to take air from the water surface and the rapid movement of the operculum are observed in fishs. The affected fishs are easily caught by hand.

Brachiomycosis is primarily gill disease, and it causes melting, adhesion and necrosis in the filaments leave their grip and fall. In the later period, the deaths occur due to respiratory failure in affected fishs.

In the acute cases, there is a marble apperance due to hemorrphagi and infacture formation in the gills (streaked or marble appearance that shows infected and death tissue). Micelles obstruct blood vessels and cause thrombosis. The gills turn gray-white over time.

Diagnosis :

Diagnosis of Brachiomycosis can be made by examinating wet mouths or histopathology of lesions. Characteristic hyphae, causing deep brachial infection, are diagnostic.

APHANOMYCOSIS (EPIZOOTIC ULCERATIVE SYDROME,EUS/ATYPICAL WATER MOLD INFECTION)

EUS occurs in numerous freshwater fishs worldwide, and mortality and mobidity can be high, and epidemics can develop rapidly. Interestingly , once an epidemic has occured in an area, the prevalence and severity of future outbreaks often subside. The disease which is mostly seen in freshwater crayfish, crabs, and lobsters, also creatures seriously problems in aquaculture.

Aphanomyces invafans (piscidia =invaderis) is founded in freshwater fish. This agent is localized in freshwater aquaculture and also is seen in river region fishing.

EUS occurs mostly at water temperatures of 18-22 ° C and after period of heavy rainfail. These conditions favor sporulation of *A.invadans* , and temperatures 17-19 ° C have been shown to delay the inflamatory resonse of fish to oomycete in fish.

The hypae show thick (> 7 µm) , multinucleated, non-segmented and branching.

Life cycle ; the fungi zoospores can be horizontally transmitted from one fish to another throu ght the water supply. The active spores remain in the water for 5 days, at the end of this period the spores loss their vitally. The zoospores are capable of attaching to the damaged skin of fish and germinating into hypae. The hypae invade skin, muscle layers and internal organs. If the spores can not find the susceptible species or encounter unfavorable conditions, they can encyst in the pond environment.

The bacterials (*Aeromonas, Vibrio, Pseudomonas, Micrococcus*), the viral diseases *(Rhabdo, Birna , Reoviral*), some fungal diseases (Saprolegniosis , Achyla) and others factors (low pH degree, rainfall, the water temperature decrease, some toxins, skin destruction, canibalism) are predisposed to the occurence of this infection. The encysting property of the *Aphanomyces* patogen may play an important role in the cyle of outbreaks in endemic areas.

Pathology and clinical signs :

Aphanomyces astaci is found in joints in freshwater crayfish and caused 100 % mortality. Water temperatures is important factor in the course of the disease. If the water temperature is above 10° C acute deaths occur within 3 weeks, but as the water temperature decrease, the development of the agents slows and the deaths occur within 3 months.

The deep ulcerative lesions are observed in chronic form of the disease in fishs. These lesions are initally small erthematous foci, and then they progresses to muscle layer and are turned into the ulcerative lesions.

The intense granulamatous lesions are occured due to intensive tissue reactions. The hypae protruding from the body are typically.

The chronic and heavily stage of the disease, opened ulcerative areas that are large, hemorrhagic and necrotic lesions are occured, and as the most striking findings, epitheloid granulmatous lesions are observed internal organs.

The disease are known as RED – SPOT DISEASE, MYCOTIC GRANULOMATOSI /MG/ and ULCERATIVE MYCOSIS /UM/) due to its clinical apperance.

Diagnosis :

A presumptive diagnosis of typical EUS infection is based on the presence of deep ulcers that contain brood (at least 7 µm in diameter), aseptate hypae that are usually observed severe and chronic inflammation.

Treatment : there is no known treatment for EUS. The antibotics and antiseptics have been used, there is no evidence for their efficacy.

ICHTHYOSPRORIDOSIS (SWIMGING DISEASE , ICHTHYOPHONOSIS)

Ichthyospororidiosis is a chronic and granulamatous , and sytemic fungal disease that is mostly observed trout , and also , it is a endo fungal disease. The agent name is *Ichthyosporidium (Ichthyophonus) hoferi.* The agent is a intercellular fungal, and it's shape is oval or spheric forms, and there are many granular nucleus in the cytoplasma. The yellow-brown agents are seen during spor or rest period. Endemics have occured in freshwater and marine fishs.

The agent is usually development at 3-20 ° C intevals , but the optimal water temperature is 10 ° C . The life cycle of the this fungus is complicated. Contamination occurs with eating fungal cysts that pass into water with feces, as cannibalism, with parasites containing fungi and consumption of infected foods. The spores germinative to form amoeboblast in the digestive troot, penetrrate the gut mucosa, reach blood vascular system and spread via , the portal system and usually localizes in liver , spleen, kidney, and particularly in the muscle including the cardiac muscle. Spores are released when hypae rupture the surface of the gut or penetrate the skin to allow in infection to spread via the water.

Ichthyophonus is frequently observed in the resting or spore stage, and this is oval structure, 10-250 µm in diameter.

Pathology and clinical signs :

Clinical signs are not observed mild and moredate infections, but the apparance of sandpaper on the skin and tail area due to pathology in the subcıtaneous and muscle tissue is noticeble. A large number of nodules develop in the internal organs. The sandpaper effect due to the loss of epithelium over the proliferating fungal granulomata (ring nodules). These nodules are produced by the severe granulamatous response with large number of epithelial cells , macrophages and occasional giant cells, along tip of fungal hypae or newly develop spores. Gray-white nodules develop in the internal organs, especially liver and kidney.

Affected fishs are observed color darkening, anorexia, exophthalmus, irregularity scales, depression, swimming disorders.

The small nodules that develop in the lateral and ventral region of the disease fish grow and expand overtime. Overtime , the skin over these nodules becomes necrosis, turns black colour, falls off, and gray-white ulcerarated areas appear in the place.

There are dense fungal cysts within the ulcers, from which the cysts pass into water with discharge.

Nerological signs (swinging disease) are common in freshwater fish because of central nervous system involvement. Fishs may also have spinal curvature and darkening of the skin.

There is no treatment, and treatment is often inadequate, the fishs can not be put on the market due to mallodor, nodules and melting. The sick fishs are destroyed.

Diagnosis :

The disease can often be identified from fresh lesion material. Typical, thick-walled spores surrounded by granulomatous inflammation are seen on fresh wet mounts.

CONTROL ---- TREATMENT

1) It is impossble to control of fungal disease in natural conditions, and prevention of fungal disease is main goal in aquaculture. Predispose factors should be reduced due to limited success treatment

2) sick and dead fishs not be left in ponds. Zoospores pass into water for 24 hours even if the fish die

3) there sould be no wounds or injuries to the fish body, and ectoparasitic infections should be no in the fishs

4) stress factors should be reduced and fish density in the ponds should be balanced

5) all materials used most be disinfcted

6) there should be no feed residue in the pond

7) water sirculation should be regular and sufficient

8) dead and infertilized eggs should be cleaned from pond daily

9) the causative agent must be diagnosed correctly and the biology of the agent must be know

10) both-sytle medication is commonly used in treatment, and in application, oxygen support must be made to the pond water

11) drug applications should be made in the early morning hours when temperature change are not excessive and before feeding

12) wounded or injuried fish must be seperated before treatment

13) general drug dose should be calculated according to " mg per kg for daily", and container prepared with medication should be wooden or plastic

14) preliminary tolerans and efficacy tests are performed and the main drug application should be done after the short time

DOSE OF DRUGS AND THEIR ROUTE OF ADMINISTRATION

H_2O_2	100-500 mg / L for 1 hour, bath
	0.71-1.42 ml (35 % H_2O_2) 15 minutes, for eggs
$MgCl_2$	25mM $MgCl_2$, 1 day , bath
Malachite green	0.5 – 5 mg /L for 1 hour , bath
	50 -60 mg / L for 10-30 seconds , immersion
	10 mg / L for 30-40 minutes for eggs

	0.5 g / L 1 hour or 0.3 mg / L for eggs , bath
NaCl	20 g / L 1 hour , bath
	1-5 mg / L 1-2 minutes , bath
Bronopol	20 mg / L 1 hour X 14 days , bath
Eugenol	1-10 g / L , bath
Proxitane (5 % peracetic acite in H2O2)	100mg / L 5 minutes , bath
Azadirachtin +camphor+curcumin	400-700mg / L for 3 days , bath
Formalin	0.125-0.250 ml / L treat for up to 1 hour , bath
	250 mg/ L treat for up to 1 hour , bath
	1-2 ml / L treat for eggs for up to 1 hour , bath
	initally 15 ppm follwed by 25 ppm treat for Branchiomyces spp
CuSO4	100 mg / L treat for up to 10-30 minutes , immersion
NaOH	10-25 mg / L treat for up to 30-90 minutes , bath
Methylene blue	2 mg / L treat for up to 1 day for eggs , bath