Eye Affection Syndrome Wild and Cultured Fish

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Abstract: Fish eyes syndrome is often one of the causes which induce difficulties in the life of both wild and cultured fish. The clinical fish eye syndrome is either local or systemic. The most common syndromes affecting wild fish are exophthalmos (pop-eye) and cataracts while those recorded in cultured one are exophthalmos, cataracts and enophthalmos (sunken-eye). The syndrome is associated with various infectious causes such as parasitic, chemical, mechanical, traumatic and hormonal imbalance. The epidmiolgy of these syndromes depends on the cause of infection of the eye in both wild and cultured fishes of all species and ages. Also, the diagnosis of these syndromes depends on: case-history, behavioral abnormalities and clinical examination (clinical signs and laboratory diagnosis). Histopathological examinations of eye syndromes affecting wild and cultured fish are graded from inflammation in acute form (traumatic causes) to cataracts and keratitis in chronic form (parasitic causes), retro-retinal gas bubbles (GBD). Prevention and control of fish eyes' syndrome depends on strict hygienic measures including the use of profilactic treatment of parasitic and biological control. Treatment and removal of the causative agent are considered to be the most important factor in treating these diseases. In conclusion, eye affection syndrome is a group of non specific clinical signs which are associated with various infectious and non infectious diseases and the best approach to occular disease is the prevention or avoidance through either strict hygienic measures or treatment and removal of the causative agent.

[Noor El Deen, A. I. E and Mona S. Zaki. **Eye Affection Syndrome Wild and Cultured Fish.** *Life Sci J* 2013;10(1):643 -650]. (ISSN: 1097-8135). http://www.lifesciencesite.com. 104

Keywords: Fish; eye; syndrome; clinical examination; laboratory diagnosis

1. Introduction

Fish eye is considered a very important organ. It is adapted for the vision in air as well as waters either in wild and cultured fish which do display some differences to the mammalian eyes **(Lee, 2002).** Wild fish are free living in open water their feeding depends on phyto and zooplankton. While cultured fish are bred and live in aquaculture systems such as cages and ponds and depend on either artificial or sometimes on natural feeding **(Woo, 2006).** Eye syndrome infection is an important health problem among fish all over the world. Occular diseases of fish are common and represent a significant problem within the aquaculture industry and ophthalmic diseases that may cause the fish to be off food and leading to retardation growth **(Noor El- Deen, 2007).** The most common parasitic syndrome affecting fishes are of digenetic trematode (*Diplostomiasis* (cataracta parasitica), copepod *Ommatokoita elongate*, *Myxobolus dermatobia* while**,** keratitis, sunken eye, absence of eye, small eye and neoplasma of cornea, retina and other parts could be a result of physical, physiological and hormonal deficiency **(Bjerkas *et al.*, 2006).** The pathogenesis differs according to the route of infection **(Austin and Austin, 2007).** Hygienic measures, such as sanitation have become important aspect of aquaculture **(Bostock, 2002)**.

The use of antiparasitic, antibacterial and antifungal drugs in the treatment of eye affections are of value **(Noga, 2010).** Also, traditional medicinal plants and biological control can control some parasitic pathogens **(Noor El -Deen *et al.*, 2010).** In Egypt, many studies reported the eye syndrome affections among wild and cultured fish that recorded parasitic and non infectious causes of eye syndrome affection have much lower rates of developmental **(El-Seedy *et al.*, 2009).**

The present review is disseminating knowledge on fish eyes' syndrome in wild and cultured fish to stimulate further explanatory research that contribute in establishing a new effective strategy for prevention and control.

Etiology of eye affection syndrome

In wild fish:

Infectious causes:

Parasitic causes.

Many species of metacercariae are found encysted or free in the eyes of fish which are found within the retina, vitreous humour and lens of the eye. Greatest damage is caused by those species occurring in the lens. Possibly the most important species is *Diplostomum spathaceum* or 'eye fluke' which is found in many species of fresh water fish in Europe, Afracia and North America (**Roberts, 2012**). Some copepod parasites may be found attached only superficially and probably cause little harm to the eyes of fish. Others may penetrate deeper into the eye, causing severe damage. Also, the parasitic copepod *Ommatokoita elongata* (Grant) were collected in Arctic waters of Victor Bay, North-west Territories, Canada were firmly attached to the corneas of Greenland sharks, Somniosus microcephalus by an anchoring structure, one per eye **(Borucinska *et al.*, 1998).** Also, metacercariae that isolated from cultured Japanese eel in Taiwan caused swollen, cloudy and white eyes and the causative agent of the disease of eye of the fish, detected in three South American trout's was *Diplostomum compactum* and showed unilateral exophthalmia **(Vazquez-Gamboa *et al.*, 2001).** In Egypt**,** *Diplostomum* metacercariae infection was found in eyes of wild and cultured catfish causing unilateral cornal opacity and blindness **(Eissa 2006)**. In Nile tilapia *Diplostomum* in early stages caused exophthalmia without eye opacity and in chronic stages caused complete eye cataract and white dots around the eye cornea**.** While, *Myxobolus sp* was isolated from eye of some marine fish in red sea region (**Abd El-Monem *et al*., 2005).**

Non infectious causes:-

Physical causes.

Sudden change in water temperature, salinity and gas supersaturation are responsible for developing eye cataract and gas bubble disease in wild fish **(Woo, 2006).** Post capture eye damage to sockeye salmon may be related to supersaturation of the River in adult Columbia River fish's gas bubble disease. Moreover, exophthalmos in West Australian dhufish occurred more frequently in summer season **(Stephens *et al.*, 2002).** Cataract in atlantic salmon *(Salmo solar* L) has been recorded from subzero water temperature **(Ferguson *et al.*, 2004)**. Gas supersaturation was observed in the Parana River, Argantena. The gas bubble was observed in fins, eyes and skin **(Domitrovic *et al.,* 2000).**

Chemical causes.

Eye lesions and other clinical abnormalities are positively associated with water pollution. Inflammatory lesions of the eyes were interpreted as circumstantial evidence for contamination by wastes from titanium dioxide production **(Delthlefsen, 1984).** Eye lens cataract was common in fish of Elizabeth River, Chesapeake Bay, Virginia due to contamination of water with polycyclic aromatic hydrocarbons **(Williams *et al.*, 1992).** Skeletal deformities, scale disorientation, gill, eye, soft tissue deformities and other kinds of deformities were reported in tilapia and other native fish species from southern Taiwan contaminated rivers **(Sun *et al.*, 1998)**. The exposure of larval fishes to sewage plumes off the coast of Sydney, Australia can potentially affect the health of larvae and cause deformities to the eyes (half pigmented eyes) **(Kingsford *et al.*, 1997)**.

In cultured fishes:-

Infectious causes:-

Parasitic causes.

The available literature recorded that eye flukes, *Myxosoma sp* and metacestodes were responsible for affections in various farmed fish. *Myxosoma sarigi* isolated from the orbit and cornea of infected *O. niloticus* fishes were cultured at the kainji Lake research Institute, Nigeria **(Okaeme *et al.*, 1988).**

Ichthyophthirius multifiliis causing cataracta in ornamental Golden fish **(Noga, 2010).** In Egypt , the most common parasites were; *Diplostomum spathaceum*, or 'eye fluke'isolated from tilapia sp. at Abbasa fish farm, Sharkia **(El-Bouhy,1995);** *Myxobolus sp* isolated from *Tilapia zilli* at Giza province causing unilateral eye opacity **(Mohamed *et al.*,2004).** *Myxobolus dermatobia* **from** *Oreochromis niloticus***,** hybrid tilapia and *Sarotherdon aureu* at Kafr El- Sheikh Governorate causing petechial haemorrhages and focal to large haemorrhages in orbit**,** exophthalmia and in advanced cases unilateral eye opacity **(Abd El- Aal, 2002).** *Cataracta parasitica*, the most common cause of eye opacity is metacercaria of digenean trematodes **(Eissa, 2006)**.

Non infectious causes:-

Physical causes.

Cold, rapid fluctuations in water temperature, high water temperature, direct of water flow are important physical factors for inducing eye affection in fishes **(Woo, 2006).** Atlantic salmon (*Salmo salar* L) cultured in nets in sea water was appeared in some of them cataract after a period of elevated surface water temperature with simultaneous rapid in water temperature **(Bjerkas and Bjornestad, 1999).** Gas supersaturation, change in breeding techniques, temperature fluctuation and seawater transfer time are capable of development of eye abnormalities and other clinical signs in cultured fish as rapid growth rate and most severe cataracts in Atlantic salmon during the rearing stage **(Bjerkas *et al.*, 2001).**

Mechanical causes.

Corneal abrasions and ulcerations are common squeal of trauma, especially in large individuals. This can result not only from fighting, but also, from bumping into sharp objects, such as rocks or coral, in an aquarium. Ophthalmic trauma, which can eventually lead to phthisis bulb, is common in large aquarium fish **(Noga, 2010).** Phacogenic uveitis is often found in Rainbow trout, *Salmo gaivdneri* association with the lenticular lesions, and retinal detachment often occurs as a result of vitreous trauma **(Shariff *et al.,* 1980).** As a result of probable damage of common snook broodstock Centroponus undecimals during netting from Terra Ceia Bay, Florida, USA, the cornea of most fish in captivity began to turn opaque white within 24h.of capture, while, the untreated fish became blind **(Kraxberger-Beatty *et al*., 1990).**

Hormonal causes.

Injection of high doses of methyl tostesterone and L-thyroxine inhabited growth and was bulging eyes of Red sea bream, *Pagrosomus major* and cultured *O.niloticus* caused cornal opacity **(Aml El-Asaly, 2004).**

Therapeutic causes.

Incriminated Nugvan used to control sea lice on salmon was found to induce cataract in seabass (*Dicentrarchus labrax L*) **(Bjerkas *et al*.,2003).** Corneal opacity was observed with the deficiency of Ascorbic acid **(NRC, 2011)** and probiotic in tilapia *O. niloticus* **(Taoka *et al*., 2006**).

Physiological causes.

The cataract observed in rapidly growth Atlantic salmon *Salmon salar L*. smolt in Norway might be related to smoltification process **(Bjerkas *et al.,* 2006).**

Epidemiology of eye affection syndrome

Eye affection syndrome is a group of non specific clinical signs which were associated with various infectious and non infectious diseases. Therefore, the epizootiolgy of this syndrome is dependent on the cause of eye disorder. This problem is worldwide in distribution affecting both wild and cultured fishes of all species and ages.

Incidence of eye affections syndrome:-

In wild fish.

The available data showed that prevalence of eye lesions ranged from near negligible level to 100% **(Eissa, 2006).** In addation , **Iglesias *et al.* (2001)** recorded three species of *Myxobolus (Myxobolus dermatobia, Myxobolus spheroidalis* and *Myxobolus ocularis)* in different locations in the skin, gills and eyes of *Chondrostoma polylepis* in Galilcia, New Spain.

Naturally occurring cases of exophthalmos that examined were mostly unilateral and occurred more frequently in summer months during periods of increasing water temperature. Changes varied from a hazy opacity in the interior part of the lens to cataract affecting the whole lens. Severely affected lenses appeared swollen and large vacuoles were visible in the opaque areas. Large vacuoles in the otherwise clear lenses were seen in 1 of 4 adult salmon examined **(Bjerkas *et al.*, 2003)**.

In cultured fish.

Numerous reports have been released concerning the prevalence of eye affection syndrome in aquaculture. They reported that the spreading of the eye problems among cultured fish is worldwide in distribution.

In Egypt, *Myxobolus sp* were isolated from both *Tilapia sp* and *Clarias lazera* at Behera province causing unilateral eye opacity. *Myxobolus spheroidalis* and *Myxobolus ocularis* from *Oreochromis niloticus* were illustrated to cause exophthalmia and in advanced cases unilateral eye opacity **(Abu El-wafa, 1988)**.

Cataract and other optical changes in traditional pond farms in lower Saxony, Germany was low incidence **(Schlotfeldt and Wegener, 2000)**. They also added that the cataract problem and more severe eye changes. Also, present in freshwater fish farming, seen to be less prevalent than the marine production of Atlantic salmon. The prevalence of cataracts in seawater farmed atlantic salmon, *Salmon salar* was 83% in spring entry groups and 79% in autumn entry groups respectively **(Ersdal *et al.*, 2001)**. Spontaneous exophthalmos was common in cultured West Australian dhufish Glaucosoma hebraicum Richardson which is a potentially valuable aquaculture species **(Stephens *et al.*, 2002)**.

Factors influencing the eye affections syndrome:-

The incidence of ocular abnormalities is greatly affected by various factors involving fish type, species, age, environmental temperature and others **(Woo, 2006)**. Eye disorders are more common among farmed fish because stresses associated with culture (overcrowdness, artificial feeding, unfavorable water quality, rough handling) render them more susceptible than feral fishes. The rate of eye diseases varies from one species to another **(Woo, 2006).** Pop - eye which is the main signs of GBD can be seen in winter **(Isaacson, 1977)** as well as in summer **(Stephens *et al*., 2002).** The West Australian dhufish, **Glaucosoma hebraicum** Richardson (family Glaucosomatidae) is a potentially valuable aquaculture species, but spontaneous exophthalmos is common in freshly caught and cultured dhufish. Naturally occurring cases of exophthalmos that examined were mostly unilateral and more frequently in summer during periods of increasing water temperature **(Stephens, *et al*., 2002)**. Meanwhile, chemical pollution enhances to a great extent the eye disorders incidence of deformities in larval fishes **(Kingsford *et al*., 1997)**, in tilapia and other native fish species from Southern Taiwan contaminated rivers (**Sun *et al*,. 1998).** Eye lens cataract was reported to be the most common sign in some fish species in Poly cyclic aromatic hydrocarbons heavily contaminated sites of the Elizabeth River, Virginia, USA was reported **(Williams *et al*., 1992)**.

Epidemiological occurance of eye affection syndrome:-

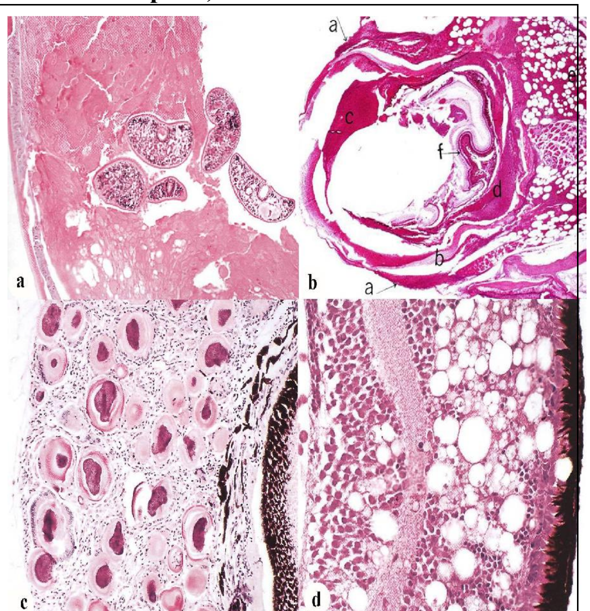
Depending on what was mentioned earlier, it is clear that there are several epizootiological patterns of eye affection syndrome due to cause's variation.

The most common eye affection was *Cataracta parasitica* which caused by metacercaria of digenean trematodes (mostly *Diplostomum sp*) which is found in fishes as second intermediate host **(Karvonen *et al*,. 2001).** Several fish-eating aquatic birds are the primary hosts of the fluke. Adult trematode in the birds produced large amount of eggs that shed and passed in feces to the water and fish **(Eissa, 2006).**

Gas-bubble disease due to helicopter was transport in young pink salmon **(Hauck, 1986)**. It has now been observed clinically in a wide variety of farmed species and under a number of different circumstances. Uni or bilateral exophthalmia, another pattern of occurrence and associated environmental and management factors were detected **(Speare, 1998).**

Pathological changes of eye affection syndrome

The eye affection syndrome is associated with infectious and non-infectious diseases, the different pathogenesis should be considered**.** Histopathological examination of eye affected by several fluke larvae within the lens revealed localized granulomatous reactions around the dead ones **(Saburoh *et al*., 1982)**. As showen in **plate,1.**



Plate(1). (a) Diplostoma in tissue of cornea , **(b)** Infected eye. Bacteria invade the conjanctiva(a), sclera (b), iris(c), choroid(d) and orbital adipose tissue(e) ,the retina(f) is separated,the eye ball is forced out of the orbit. H-E, x 10.,(c) Retinitis in tissue of cornea .**(d) .** Uveitis and vacuoles are the typical findings which are seen in all layers of the retina **(Saburoh *et al*., 1982).**

Diplostoma in tissue of cornea causing eye opacity**.**. Corneal epithelial ulceration and heterophilic keratitis was observed **(Reborts, 2012)**. As shown in **plate,2**. Epithelial proliferation is a frequent finding in cataract in fish. The Occular enucleation, persistent corneal cataracts and panopthalmitis are the dramatic sequel of Gas buble disease **(Woo, 2006)**. The occular cataracts happened to yearling salmonids after seawater exposure cause damage of cortical fibers as a result of exposure to hypertonic solution and defective osmoregulation **(Bjerkas *et al*., 2003).**

Plate (2). *(a)* Epithelial proliferation, is a frequent finding in cataract in fish. (b) Massive retro-retinal gas bubbles result in unilateral loss of vision in this aquarium species, largely due to distortion of retina, **(Saburoh *et al*., 1982) .**

Diagnosis of eye affection syndrome

Case History:-

Many factors should be reported such as; recent stress exposure (overcrowdness, transportation, decrease in water flow / exchange, overfeeding) (Noga, 2010), Mechanical injury (netting, grading, fish sampling) (Kraxberger-Beatty *et al*., 1990) , rapid fluctuation in water temperature, sudden increase (Eissa and Zaki, 2010) or decrease in water temperature (Bjerkas and Bjornestad, 1999) , snails and aquatic birds spreading (Eissa, 2006) and chemical pollution (Williams *et al*., 1992) should be considered in diagnosis of eye affections .

Clinical examination:

Fish should be examined first for detection of any behaviour changes, then representative fish sample was taken and fish were inspected individually for detecting gross lesions.

Behaviour abnormalities.

Fish floating to water surface and increase in time devoted to feeding (Noor El-Deen, 2007), random swimming into objects (Karlsbakk *et al*.,

2002) and sluggish movement (Ness and Foster, 1999) are considered the most common behavioral abnormalites.

Clinical signs.

Most common clinical signs were stunted growth (Ersdal *et al*., 2001), acute or chronic mortality (Sogma *et al*., 1999), Diplostomum flukes (Eye flukes) (Crowden and Broom, 1980), adult female Ommatokoita elongata **(Borucinska *et al*., 1998),** exophthalmos(Saburoh *et al*., 1982). **Plate,1(a,b,c and d).**

Myxobolus cysts, endophthalmos (Noor El - Deen, 2007), Cataracta parasitica in Tilapia (Eissa, 2002). **Plate,2 (a,d,c and b)** . unilateral or bilateral eye lens opacity cataract (Vasquez-Gomboa *et al*., 2001 and Austin and Austin, 2007), unilateral or bilateral exophthalmos (Russo *et al*., 2006), presence of gas emboli (Domitrovic *et al*.,2000). Plate,3(d), Vision impairment (Bjerkas *et al*., 2003),("pop-eye) (Eissa, 2006), blindness (El-Bouhy, 1995.

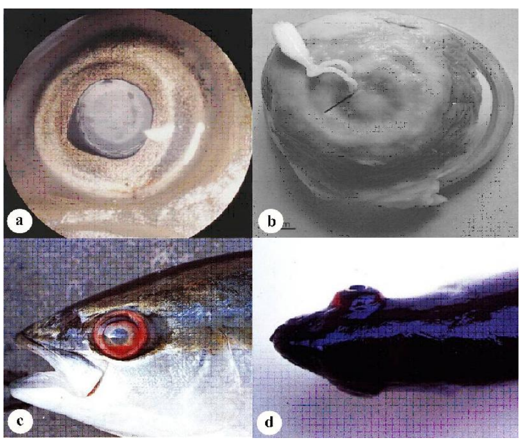


Plate (1). (a) Diplostomum flukes (**Eyeflukes**) showed in the cortical layer where there is a concurrent cataract development (**Saburoh *et al*., 1982).** (b) The eye of a Greenland shark infected with adult female Ommatokoita elongata (arrow indicates point of parasite attachment) **(Borucinska *et al*., 1998). (c)** A yellowtail fish exhibits exophthalmos with hemorrhage of the conjanctiva and iris **(Saburoh *et al*., 1982). (d)** This fish exhibits exophthalmos. **(Saburoh *et al*., 1982)**.

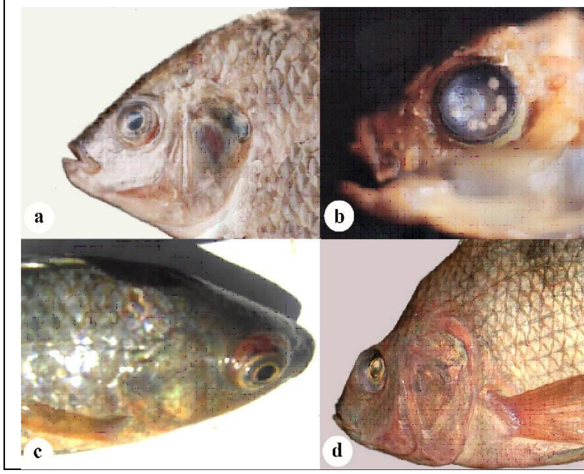
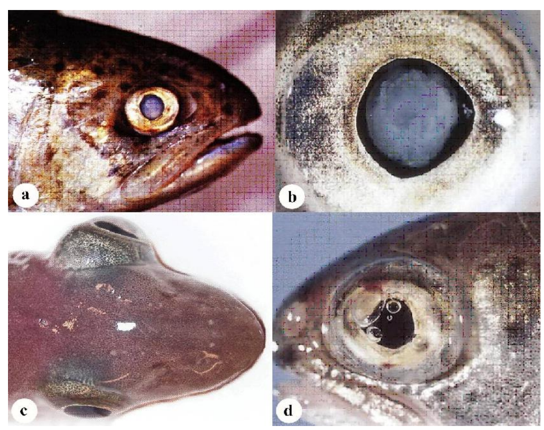


Plate (2). Myxobolus cysts in the eye and slight exophthalmos **(Noor EL- Deen,2007).**

(b): Showing Cataracta parasitica in Tilapia **(Eissa, 2006).**

(c) *Oreochromis niloticus* with exophthalmia eye **(Noor EL- Deen, 2007).**

(d) *Oreochromis niloticus* with sunking eye **(Noor EL- Deen, 2007).**



Plate(3). (a) A rainbow trout with cataract and a cloudy lens **(Saburoh *et al*., 1982).**

(b) Diplostomum flukes (**Eyeflukes**) in the cortical layer **(Saburoh *et al*., 1982).**

(c) Retrobulbar gas has pushed the eye forwards and out of the orbit, resulting in exophthalmia in this cod **(Saburoh *et al*., 1982).**

(d) Small gas bubbles in the anterior chamber of rainbow trout**(GBD) (Saburoh *et al*., 1982).**

Laboratory diagnosis.

First, freshly prepared fish samples are essential for isolation and identification of parasitic, bacterial, fungal and viral examinations**. Parasitic diagnosis** depends on isolation and identification according to **Lukey (1977)**

Prevention and control of eye affection syndrome

Numerous studies with controlling of eye affection syndrome in wild and cultured fish were concerned.

Managemental prevention.

Quarantine of new fish and good sanitation practices should be used at all times **(Eissa, 2006).** Nutritional deficiency as a cause of eye syndrome affections should be balanced **(Noga, 2010).** Stress factors must be avoided with added to the feed anti stress substances such as ascorbic acid **(Taoka *et al.*, 2006).** Also, Aerating the water sources in a reservoir to allow it to equilibrate with air or stripping of excess gas by using vaccum, the excess gas may leave solution in the blood stream, forming emboli in various tissue causing gas bubble disease **(Woo,2006).**

Drug therapy control.

In parasitic infections and /or infestations.

Antiparasitic drugs should be used as in case of eye fluke *Diplostomum spathaceum* in Channel catfish which treated with 2 mg Praziquantel/l in water bath for 2-4 h **(Plumb and Rogers, 1990).** Eye affections associated with parasitic infections and/ or infestations, antparasitics were recommended for controlling of this condition. An oral praziquantel used as inhibiting attachment of parasites to *O. nilotcus* **(Osman *et al.*, 2008)**. Recently, electrical currents, ultraviolet radiation and supersonics are used for eradication of cercariae **(Eissa, 2006).**

Biological control.

In addition to controlled indirectly through eradication of snails. Several methods were used for snail destruction, but abiological control by black carp is the best **(El- Khatib, 2003)**. Avoid exposure of culture waters to the aquatic birds **(Noga, 2010).** Probiotics, live microbes that may serve as dietary supplements to improve fish immune responses, have received some attention in aquaculture **(Kesarcodi-Watson *et al.*, 2008)**.

Conclusion:

Fish eyes syndrome is a disease that causes many problems to both wild and cultured fish. Treatment of this syndrome in wild fish depend on great extent on getting rid of the causative agent. In cultured fish, prevention and control of fish eyes' syndrome problems could be balance of nutrition.

Methods used to control occular diseases are:- Good farm management, environmental stresses and associated disease, high water quality, applying lime to the ponds, low rearing densities, and excellent nutrition. Quarantine and health certificate form which is a part of the control microbial diseases.- Paying attention for eradication of any parasitic, bacterial, fungal and viral causes in fish farm. Employing some molluscicides chemically or biological and trials for elimination of the aquatic piscivorous birds, dead fish. Application of vaccination programs for fish, or using medicinal plant extracts which are the alternatives to the antibiotics for preventing and controlling the infectious diseases in fish farms. Recently, electrical currents, ultraviolet radiation and supersonics methods are used for eradication of cercariae in cultured fish at water inlet.

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12/20/2012