Introduction
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India is basically an agricultural country, where livestock constitute an important component of animal wealth. Likewise, India is also known for its rich fishery resources and occupies prestigious second rank next to China with regards to fish production from inland water bodies. Fishes are the most diverse vertebrate group with approximately 25,000 recognized species, comprising about half of all known vertebrate species. Fishes are an important source of protein for million of people worldwide. Since the early 1970s, 70 to 100 million metric tons of fishes are caught each year for food. People consume about 70 percent of fish caught, and nearly 30 percent are used as animal feed that helps to produce other forms of proteins. Therefore, importance of fishes cannot be ignored as they provide flesh as a nutritional source, ornamental means and provide variety of essential by-products such as fish protein, fish glue, used as fertilizers, bait etc. In addition to protein, it contains carbohydrates, vitamins, (A, Bcomplex, and D) iron, calcium and other mineral salts, as well as highly digestible essential amino acids like taurine and fats (8-10%) rich in long chain omega 3 polyunsaturated fatty acids. Fish meals are also rich in a wide range of minerals and trace elements including zinc, selenium and copper. Fish oil is rich in vitamins A and D with lower levels of vitamin E than in fish meal. Some larvivorous fishes such as Puntius sophore, Rasbora daniconius, Esomus danricus, Channa orientalis, Mystus vittatus and Trichogaster fasciatus generally feed on mosquito larvae, therefore used as means of biological control and is useful in controlling malaria, yellow fever and other dreadful diseases. Several species of salmonid parasites, such as Anisakis species (a nematode or round-worm), Diphyllobothrium species (a cestode or tapeworm) and Nanopyetus salmincola are of public health concern. Inspite of being too much advantages, the population of fish species is going down tremendously due to the outbreak of diseases, particularly caused by platyhelminth parasites, leading to great loss in the economy of India therefore there is need to overcome the problem.
**Figure 1** Shows Host- *Trichogaster fasciatus*
Parasite- progenetic metacercariae of *Clinostomum complanatum* and infected liver of the host.
Trichogaster fasciatus

Clinostomum complanatum

Infected fish liver

Figure 1
Parasitic infections are most problematic when fish is consumed in its raw form or in improperly cooked form. An aquaculture assumes an expanding role in meeting consumer demands for fishery products, it is natural that they meet safety and quality standards. But fish diseases represent one of the most crucial problems and challenges in aquaculture production both from an economic and sanitary point of view. Global aquaculture production is estimated at nearly 10 million metric tons annually, and it contributes more than 12% of the total consumed fish and shellfish (Perez and Rodriguez, 1997). It is difficult to evaluate the real economic losses, due to different related factors, however it has been estimated that 10% of all cultured aquatic animals are lost as a result of infectious diseases (Leong and Fryer, 1993). In fish diseases a simple association between the pathogen and fish does not occur. The occurrence of disease upon interaction of the pathogen with the fish depends on the several host factors such as age, size, developmental stage, nutritional and reproductive status and immunological defenses of the host. Kurochkin (1984,1985) estimated that at least 30,000 species of helminthes had already been described from marine animals. Between 20,000 and 30,000 species of fish are known and each is likely to harbour a few species of helminthes. It follows that a very large number remains to be discovered and described. The digenetic trematodes which cause infection in fish represent largest group of platyhelminthes. About 1700 species of adult digeneans infect fish. Metacercariae are even more common than adults. Blood flukes cause considerable damage to the gills and impair respiration. Adult worms and eggs can physically obstruct the passage of blood, causes thrombosis and subsequent tissue necrosis (Hoffman et al., 1985). In chronic infections, adult worms disperse and become stranded in the heart, kidneys and caudal vessels. Metacercariae do not have debilitating effects on fish; sometimes even when the number of parasites is relatively high, no visible structural damage in the organs are observed. Sudden massive outbreak of infection is often fatal. Cercariae penetrate and encyst deeper in the tissues of small fishes and relatively larger cysts may interfere with organ function. Pronounced inflammatory response often accompanies penetration and early migration. Fish may even die from the penetration wounds caused by trematodes. They may cause some disruption of connective tissues, inflammatory cell proliferation, sometimes myofibrillar necrosis and reactive swelling of intermuscular
septa. Digenean larvae which occur in liver and other visceral organs cause severe melanosis of the liver and visceral fibrosis. It also reduced growth and contributed to mortality of fingerlings. These parasites also elevated β and γ-globulin serum levels, but decreased albumin levels.

During the course of their life cycle, larval stages pass from free living stage to an invertebrate host and then develop finally with or without a short free living period in definitive vertebrate host. Second asexual phase of reproduction in intermediate host has considerable importance as it helps in propagating their progeny in geometrical ratios. The metacercarial stage is important because of its longevity and potential to infect second intermediate host for a relatively longer period of time. Metacercariae which are motile feed on host tissue and cause damages, for example: *Diplostomum* in eye and brain of amphibians and fishes. Some other parasites cause minor hemorrhage resulting in deficient feeding, shortening life span and fecundity of host.

The metacercariae of *Clinostomum complanatum* is known as progenetic metacercariae showing advanced developed genitalia (which may or may not attain actual maturation). The metacercariae of *C. complanatum* is known to lodge in peritoneal cavity of *Trichogaster fasciatus*, which serve as second intermediate host of the parasite. Khalil (1971) listed over 50 species of trematodes from 15 families, occurring in a variety of freshwater fishes in Africa. One representative of *Didimozoidae* (parasites of fish tissues and internal cavities, *Nematobothrium labeonis* occurs in unencysted form in eye orbit of *Labeo species* in Sudan Nile), generally metacercarial infections are common in all inland water bodies in Africa and Near East (Paperna, 1964; Paperna and Thurtson, 1968; Khalil, 1969; 1971; Van as and Basson, 1984) Piscivorous birds are said to be the definitive host of *Clinostomum complanatum*, while snail serve as the first intermediate host. It is said that aquatic birds help in the dispersal of aquatic snails, which may possibly be *Bulinus truncatus, Lymnae* and *Molannoides tuberculata*, and after that metacercaria find its way towards its second intermediate host i.e. its particular fish host. These parasites are also known to possess zoonotic potential as human case is reported in Korea (Chung et al., 1995) caused by consumption of improperly cooked or raw fish which is a global public health problem affecting millions of people, particularly poor vulnerable groups in developing countries. About 700 million people around the
world are at risk for food-borne trematode infections (FBT), 40 to 50 million people are infected with one or more of the parasite. However one of the major concerns today is disease outbreak among fishes leading to mass mortalities and consequent economic loss. Diseases caused by parasitic infections have adverse effects not only on animal health but also on the environment.

**Life-cycle:** - The life cycle of *Clinostomum complanatum* (Rudolphi, 1814) has been explained by many workers like Souza *et al.*, (2001). Adult flukes lay their eggs in the mouth of heron host which get access into water when the birds dip their head into water to capture fish. These eggs are either embryonated or unembryonated. The developed ones hatch almost immediately upon reaching the water, while undeveloped eggs require about 19 days hatching. The active miracidia are covered with cilia having three pigmented eye spots arranged in a triangular form and contain a single germ ball. Upon coming in contact with snail they burrow into the tissue. Inside the snail, miracidia shed ciliated epithelium and migrate to digestive gland or liver. They are thin walled sac like creatures with three eye spots, but lack a birth pore. Inside them are several germ balls which develop into rediae. The first generation rediae escape from mother sporocyst and locate in digestive gland or liver. Each redia contains 3-15 developing daughter rediae. The second generation or daughter rediae are recognizable by cuticular folds, masses of developing cercariae and a birth pore in anterior fourth of the body. Cercariae after full development, escape from snail into water. They are pharyngeate and breviform i.e. having short furcae at the end of a short tail stem, 2 eyes and a longitudinal fin over dorsal side of the body. Upon coming in contact with fish, the cercariae attach to skin and burrow therein. In subcutaneous tissue and muscles, they develop in about 20 weeks into large precocious metacercariae known as yellow grubs. When infected fish are eaten by herons, the metacercariae release probably in proventriculus and migrate to buccal cavity. They attain sexual maturity in mouth of herons in 3 days, remain therein about two weeks and then are lost. In India, the second intermediate host is mainly *Trichogaster fasciatus* fish (Bloch and Schneider, 1801). It is a freshwater carnivorous fish, highly esteemed as food. Due to its carnivorous habit, it feeds on mosquito larvae and can be recommended for stocking ponds and tanks as an antimalarial measure.
Figure 2: - Life cycle of *Clinostomum complanatum*.

1. Indicates adult *Clinostomum complanatum* and definitive host of *Clinostomum complanatum*. (Bird, *Ardea herodias*).
2. Indicates egg of the parasite.
3. Free swimming miracidia released after full development penetrating into its first intermediate host i.e. snail.
4. Indicates first intermediate host of *Clinostomum complanatum*. (Snail)
5. Cercariae escaping from snail into water and upon coming in contact with fish enter in its skin and penetrate into it for further development.
6. Indicates second intermediate host (*Trichogaster fasciatus*) of *Clinostomum complanatum*, in which cercariae further develops into large metacercariae. Figure above showing metacercariae.
Figure 2: Life cycle of *Clinostomum complanatum*
Despite the economic importance of fish in our national economy and a significant component of food security system in India, attention has not been paid to improve the fish health and save them from an array of infectious agents including trematodes. Before embarking upon any control measure it is necessary to have an insightful background of the parasite metabolism, host-parasite relationship, diversification of biomolecules and adaptations found in micro and macro environment. Application of single method for the control has some limitations and has its own problems. Therefore, an integrated approach is being preferred. Apart from studying physiology, sound knowledge of parasite biochemistry is required for the development of new drugs and effective vaccines. The literature relating to biochemistry and physiology of trematodes have been reviewed by many workers (Von Brand, 1973, 1979, Barret, 1981, Smyth and Halton, 1983 Smyth, 1996). The biochemical peculiarities identified in the parasite and host can be exploited for the application of chemotherapeutic and immunologic control measures.  

Aim of the present study was to obtain basic informations pertaining to pathological enzyme markers like GOT, GPT, AcPase and AlkPase. Changes in polypeptide profile have also been studied in diseased and normal Trichogaster fish. In the present study, percent infection, worm burden and morphometric analysis of Trichogaster host has also been included.