REFERENCE ONLY

Winter School on

'RECENT ADVANCES IN DIAGNOSIS AND MANAGEMENT OF DISEASES IN MARICULTURE'

7th to 27th November, 2002

Course Manual

Organising Committee

Prof. (Dr) Mohan Joseph Modayil
Director, CMFRI

Course Director

Dr. K. C. George
Principal Scientist,
Division of
Physiology, Nutrition and Pathology

Co-ordinators

Dr. R. Paul Raj, Head, P N P Division

Dr. P. C. Thomas, Principal Scientist

Shri. N.K. Sanil, Scientist (Sr. Scale)

Dr. (Mrs.) K.S. Sobhana, Scientist (Sr. Scale)

Indian Council of Agricultural Research
Central Marine Fisheries Research Institute
P B. No. 1603, Tatapuram P.O., Cochin 682 014

पुस्तकालय
Library
केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान
Central Marine Fisheries Research Institute
कोची-682 018 (भारत)

FISH DISEASES IN INDIA, THEIR CAUSES AND CONTROL MEASURES

Dr. S. C. Mukherjee
Director, Central Institute of Fisheries Education, Mumbai

Introduction

In recent years intensive fish culture is being practiced in the brackishwater, coastal water and freshwater impoundments of India. Recent techniques of intensive and super intensive fish culture involve high rates of stocking and supplementary feeding which has substantially enhanced the incidence of diseases in fishes in our country.

In the first two decades of post-independence, lot of interest was paid to Inland fisheries and considerable amount of attention was paid to diseases in cultivable fishes in various states. Fishes suffer from a wide variety of diseases of infectious and non-infectious etiology in their natural environment. Number of literatures are available on fish mortalities due to bacteria, parasites, fungus, nutritional deficiencies, metabolic disorders and faulty environmental conditions like oxygen deficiency, high or very low water temperature, chemical pollutants, over crowding, mal-nutrition, algal blooms etc.

In India, traditional aquaculture has in recent years turned into a science based economic and commercial activity involving heavy inputs, and therefore diseases of all kinds are now known to occur on an increasingly larger scale. However, fish mortality is not the only criterion to evaluate the effect of fish disease. Even the morbidity, which leads to weight losses and poor growth in surviving fish, contributes substantial losses to the farmers. Since last decade there is an increased realisation of the necessity to avoid infectious agents to maintain healthy stocks to enhance production.

Bacterial diseases

Innumerable diseases are caused in fishes due to bacterial pathogens and several of them are reported in Indian literature. They occur in nursery, rearing and grow out ponds causing serious concern to fish farmers. Some of them often wipe out the entire population of fish. Some of the important bacterial pathogens are *Aeromonas hydrophila, A. salmonicida, Pseudomonas fluorescens, Pseudomonas putrefaciens, Flexibacter columnaris, Edwardsiella tarda, Vibrio alginolyticus* and *V. parahaemolyticus* which have been identified as most commonly encountered agents in fish diseases. Symptomatology, clinical pathology, microbiology and anatomic pathology have been carefully correlated to arrive at the diagnosis of the diseases caused by these organisms.

Hora and Pillay (1962) and Gopalakrishnan (1963) have reported fin-rot both in young and adult fishes. They have inferred that the disease is contagious and is capable of causing immense damage. However, none of them could attribute any particular pathogen for the disease. Recently, scientists at CIFA have reported that the fin and tail rot in young fish are due to a mixed infection of *A. hydrophila* and *Pseudomonas fluorescens*. Earlier workers suggested some control measures like bath treatment in 1:2000 copper sulphate for 1-2 minutes or painting of concentrated copper sulphate solution in the affected fish (Pal & Ghose, 1975).

Dropsy is another important fish disease in India where rohu, catla and mrigal are affected mostly in the late winter. Several workers have reported occurrence of the disease in composite fish culture ponds (Pal & Tripathi, 1978). The epidermis and body cavities get filled with fluid and scales protrude out from their pockets leading to severe anaemic condition. Pal and Tripathi (1978) although did not isolate the causative agent, could treat the affected fishes fully using terramycin in the feed. Kumar *et al* (1986) revealed a mixed infection of *A. hydrophila* and myxosporidian parasite in case of infectious dropsy in *Catla catla*. Histopathological changes in cases of dropsy have been described by theses workers. Mukherjee *et al* (1992) have attributed cases of dropsy of *A. hydrophila* in conjunction with malnutrition.

Another bacterial disease in the epidemic form has been studied by Gopalkrishnan (1961), and Kumaraiah (1977), the causative organism of which is identified as *A. liquifaciens* infecting the eyes of catla. The corneas of the eye gets vascularized leading to opacity and complete necrosis resulting in the death of the fish. Gopalakrishnan and Gupta (1960) have noted that optic nerves and brain are the primary sites of the infection. Corneal opacity in silver carp (*Hypophthalmichthys molitrix* val.) due to Gram positive bacterium, *Staphylococcus aureus* was reported by Shah and Tyagi (1986). Jhingran (1991) also could observe similar eye disease in epidemic form in *Channa marulius* and attributed it to the same type of organisms. Mukherjee and his co-workers (1992) have recorded a mass mortality in silver carps in a government farm and isolated *Staphylococcus aureus* from the affected eyes of diseased fish. Chloromycetin bath @ 8-10 mg/litre of water has been found effective in controlling the disease at an early stage by some pioneer workers. Disinfecting the environment with $KMnO_4$ at a dose of 0.1 ppm followed by liming @ 300 ppm check the disease as reported by Kumaraiah (1977).

Myxobacterial organisms have been attributed to a condition known as gill hyperplasia syndrome in common carp (*Cyprinus carpio*) as reported by Kumar et al (1986 d). The infectious nature of the disease has been proved by transmitting the disease in Asiatic major carp species through contact. These workers have conducted some antibiotic therapy, but could not succeed in getting any significant result.

Ulcerative disease in catla has been reported by many workers where bilateral ulcerations of the opercula and the head are observed. In several cases the ulcerations have been reported to have penetrated the opercular bones and cranium. Gopalakrishnan (1963) and Karunasagar et al (1986) have investigated several such outbreaks. Kumar *et al* (1987) have studied this condition in composite fish culture ponds. In most of the cases *A. hydrophila* could be isolated, although several other bacterial forms were also present as secondary invaders. Mukherjee *et al* (1991) have reported the role of *A. hydrophila* in ulcerative disease of fish and identified the biochemical differences among the various strains of these organisms. Nayak and Mukherjee (1994) made a detailed study of the biochemical properties of these organisms and drawn antibiograms on the basis of the antibiotic sensitivity tests.

In a recent study these workers have elucidated the role of *A. hydrophila* in dropsy, fin and tail rot and more elaborately in epizootic ulcerative syndrome. It is beyond doubt that in the ulcerative disease of fish these organisms might be playing an important role not only in necrotizing the muscle tissue but also damaging the internal organs viz. Kidney, liver and spleen.

Another disease of similar nature causing external lesions over the surface of the body has been described by Kumar *et al* (1986 C). The causative organism has been identified as *Flexibacter columnaris*. Topical application of potassium permanganate or short bath in 500 ppm of $KMnO_4$ has been found to be very effective in completely curing the disease.

A septicaemic disease called Edwardsiellosis has been reported by Kumar (1989) affecting brood fish population. *Edwardsiella tarda* has been isolated from the diseased fish showing anaemia, cutaneous lesions and gas filled abscesses in the muscle. Although the mortality was not too high, but the morbidity has been reported to be extreme. Very recently, large-scale mortality in the spawn of Indian major carps has been reported by Mukherjee *et al* (1994) in an organised hatchery. *E. tarda* could be isolated from the disease affected spawn. The young ones showed anatomical deformities and greyish white discolouration of the body within 48 horus post-hatching and died within 72 hours. Although treatment with Iodophor has been found to be effective, water quality improvement in the hatchery is the most essential component for keeping this disease away.

Epizootic Ulcerative Syndrome (EUS) is hitting the headline of the country since last six years and has become a matter of tremendous concern not only among the fishermen and fish farmers, but also among general public, entrepreneurs, administrators and planners. Initially the epizootic was mainly reported from the NorthEastern States of the country in the year 1988. Gradually, it has spread throughout the country. At the moment it has engulfed the entire length and breadth of the country barring only few states like the Punjab, Jammu and Kashmir, Himachal Pradesh and Gujarat. Mukherjee (1994) has reported this not only in the freshwater fishes, but also brackishwater fishes in Orissa, Kerala, Karnataka and Goa. One common feature of the disease is that it initially affects the bottom dwelling species like murrels followed by catfishes and weed fishes. Subsequently other fishes including Indian major carps are affected. Although the extent of economic loss has not been properly quantified, loss incurred by the fisheries sector due to this particular disease runs to several crores of rupees.

The lesions start as small grain to pea-sized haemorrhagic spots over the body, which ultimately turn into big ulcers of the size of a coin with greyish slimy central necrotic area surrounded by a zone of hyperemia. The disease affects the fish to such an extent that they start rotting while still alive and eventually die.

A number of bacteria viz. *Aeromonas hydrophila, A. punctata, Flavobacterium* sp., *Pseudomonas* sp., *E. tarda, V. parahaemolyticus* and *Streptococcus* sp., have been isolated from the affected specimens (Kumar, 1989). Histopathological studies revealed complete loss of epidermis in the ulcerative area of the skin where the dermis and hypodermis showed characteristic granulomatous changes (Dey, 1989), Gill tissue showed hyperplasia of the secondary lamellar epithelium, fusion of lamella and clubbing of gill tips. Haemopoietic tissue of the kidney showed proliferation of macrophages. Besides bacteria, virus, fungus and parasites were also reported to be associated with epizootic ulcerative syndrome (Kumar *et al*., 1989; Dey, 1989).

Several methods have been tried or are being tried to control the disease. Many antibiotics, sulfonamides, chemicals, herbal preparations etc. have been advocated as preventive and curative measures. Lime was accepted widely among the fish farmers of

the country until the formulation of a medicine by the scientists of CIFA. Marked improvement of the ulcerative condition is noticed within 7 days of application of the medicine and the ulcers are healed up within 10-14 days. The medicine acts as a preventive also. Records reveal that there is no recurrence of the disease for at least eleven months in the ponds where the medicine is applied. The cost of application is only Rs.260/- (Approx. $ 8 US) for one Ha-m water body.

Protozoan diseases

Myxosporidia are one of the most important groups of pathogen capable of producing diseases in fish causing heavy loss in the juvenile. Several species of this pathogen have been reported from various parts of the country (Chaudhuri and Chakravarty 1970, Karuchandani, 1970; Senappa and Manohar, 1980; Sanaullah and Ahmad, 1980; Ahmad 1982; Dey et al 1988). These workers have reported great problems and heavy losses in intensive fish culture and fish seed rearing due to emaciation and asphyxiation. Myxobolus cysts of varying sizes have been reported on the gills and kidney of *Catla catla*. Larger cysts are located at the distal end of the gill filament where as smaller ones is seen at the proximal end. Infection damages the respiratory surface of the gill and excretory tubules of the kidney. Diagnosis of the disease can be made on the basis of gross appearance of the pin head sized greyish cysts and large number of myxosporidian spores under the microscope.

The other groups of protozoa infecting fish belong to ciliophora. The carp fry and fingerlings sometime carry heavy infection of the gills and skin with *Trichodina indica*. In heavy infection there is excessive mucus secretion on the gills which hampers respiration and the fish start surfacing. Some species of trichodina occur inside the urinary bladder. Under microscope they appear as circular transparent organisms with an internal disc-like structure. Fish affected with trichodiniasis eventually turn sluggish, lose weight and become moribund. There may be excessive mucus secretions and epidermal necrosis. A short bath in 2-3% salt solution for 5 minutes can control the infection effectively.

Whirling disease in *Cirrhinus mrigala* (Ham) observed by Maheswari (1986) has been attributed to a protozoan parasite *Myxosoma cerebralis*. The gross changes are characterized by deformed spinal column as reported in European and American salmonids suffering from whirling disease.

Ichthyophthiriasis or 'white spot' disease has been reported by Gopalakrishnan (1963, 1964) causing large scale mortality in nursery and rearing ponds in different parts of the country. The fish disease unit of CIFA has also similar observations in carp nursery ponds. Presence of numerous pinhead shaped white spots on the skin, fins and gills are the common diagnostic features. On microscopic examination these spots look like blisters or nodules. Fingerlings of *Labeo bata* and *C. mrigala* have been experimentally infected with this parasite, but use of chemotherapy has not produced any encouraging result.

Helminthic parasites

Fishes are infected on their gills and skin by many species of monogenetic and digenetic trematoade and cestodes. The important monogenetic species are Gyrodactylus and Dactylogyrus. They remain attached to the skin or gills by the help of anchors which causes wounds. Their presence cause hypersecretion of mucous and haemorrhage from

blood capillaries. These wound later get infected with pathogenic bacteria and fungi. Alternate bath in 1:2000 acetic acid solution followed by bath in 2% sodium chloride solution has been found effective. Some workers have advocated dip treatment in 5% salt solution followed by bath in 1:5000 formalin.

The digenetic trematode generally infects the alimentary canal but are rarely harmful. However, in the metacercarial stage they are harmful as they get encysted in any part of the body, i.e. skin, muscle, abdominal cavity, liver, eyes and brain. In these cases fish serve as intermediate host while the final host is generally a fish-eating bird. In many carp fingerlings the 'black spot disease' is due to metacercaria of diplostomatidae. This was first reported by Ganapati and Rao (1962) in *Catla catla*. Catla and silver carp are the most susceptible species.

Cestodes are also internal parasites in alimentary canal. Their larval forms are more harmful than the adults. They are found more in catfishes than in carps. The infected fish show softening of the muscle tissue probably due to accumulation of water. In case of heavy infestation the abdomen bursts resulting in death of the fish. Bose and Sinha (1985) have described histopathological findings in cases of intestinal cestodes in *Clarias batrachus*.

Acanthocephala have been recorded from major carps and catfishes in India, but the life history or biology of the parasite has not been studied in detail. The parasite causes lesions in the intestinal wall by its proboscis.

Parasitic copepoda are external parasites infecting skin or gills or bucco-pharyngeal cavity. Amongst them species of two genera *Lernea* and *Ergasilus* are reported from Indian carps. Lernea is reported to infect fingerlings and adults of major carps especially catla. The parasite penetrates the muscles and reaches the blood vessels as it feeds on the hosts blood. The fish thus become anaemic and weak. Gopalakrishnan (1966) was of the opinion that larger number of these parasites may cause serious problems while a few may not cause any harm.

Ergasilus sp. Infect the gill lamellae. They attach themselves to the gill by the help of their hook-like second antenna. Due to this there are wounds and haemorrhage in the gill tissue. There are no reports in India where mortality of fish has taken place due to Ergasilus infection.

Crustacean parasites

Heavy mortality due to Argulosis or fish lice infestation has been reported in Indian major carps. Several species of Argulus have been reported to infect cultured fishes. These parasites inhabits the skin, fins and gills of the host and cause extensive pathological lesions in the skin showing circular haemorrhagic patches which become ulcerated. Mucous cells proliferate and copious mucous is produced. These lesions promote secondary infections like fungi and bacteria. Rohu has been observed to be the most susceptible species among the Indian carps.

Histopathological changes in rohu naturally parasitized by *Argulus* spp. have been described by Dey (1989). Skin from the parasitized areas showed epithelial degeneration, oedema and hyperplasia of dense connective tissue. Kidneys exhibited marked glomerular changes tubular degeneration and necrosis. In the liver, increased sinusoidal

spaces and focal necrotic areas were also noticed. Gill lamellae showed hypertrophy and hyperplasia in many areas resulting in the fusion of secondary lamellae, Kumar, et al (1987 b) advised weekly applications of malathion @ 0.25 ppm for three consecutive doses. They also reported that bath in potassium permanganate @ 500 ppm/minute once a week with the combination of malathion treatment is more helpful in the eradication of parasite.

Fungal diseases

Gopalakrishnan (1966) observed *Saprolegnia parasitica* in the fry and fingerlings of major carps. The disease in fish is characterized by a white to brown cotton like growth consisting of colonies of mycelium and filaments which appear as small to large patches on various parts of the body like fins, gills, mouth, eyes or muscle. Shrivastava and Shrivastava (1977) identified this infection in *Channa punctata* and opined that the infection starts due to netting injury and over-crowding or lesions caused by other diseases. Jhingran (1991) reported that saprolegnia often infects the fertilized eggs. They attack the dead eggs first and then spread to the viable living eggs resulting in their spoilage. Shrivastava (1979) has reproted infection of *Cirrhina mrigala* with *Aphanomyces pisci* where the scales became black and later fell off. The hyphae of this species were not visible like those of *Saprolegnia*. The author in the year 1982 reported other species of fungus, i.e. *Achlya orion* and *Dictynchus anomalous*.

Jhingran and Pullin (1988) have reported branchiomyces infection causing 'gill rot' in fish. They have opined that these pathogens invade the blood vessels of gills causing necrosis of the surrounding tissues also.

Apart from these *Aspergillus flavus, A. ochraceous* and *Fesiformis momiliforme* have been reported from some of the EUS affected specimens (Mishra, 1992) at CIFA.

Many workers have recommended several treatment measures to counter fungal infection in fish which include dip treatment in 3% common salt solution or 1:2000 copper sulphate solution or 1:1000 potassium permanganate solution for 5-10 minutes. A flush treatment for 1 hour in malachite green (0.1 ppm) is found to be quite effective in curbing fungal infection.

Concluding notes

Until few years from now, diseases were not considered to be a serious problem in our country, as economic losses in fish culture was not know. Recent incidences of EUS in various Southeast Asian countries as well as in our own have focussed tremendous attention on the threat the disease epidemics hold for the farmers. Economic losses of the order of US $ 10 million in Thailand and over $ 3 million in Bangladesh are lessons enough to realize their importance. Since seasonality of many fish diseases is well known in our country, experienced farmers prevent simultaneous occurrence of stressful conditions and pathogenic organisms. The recent trend on vaccination programme in fry and fingerlings will set the aquaculture programme of the country in a smoother pathway. Researchers have already developed vaccine against bacterial diseases like Aeromoniasis and Vibriosis. Some more vaccines against some of the potential bacterial diseases like Pseudomoniasis and Edwardsiellosis might bring about revolutionary changes in Indian aquaculture, for which efforts are already on in some pioneer research institutes of the country. Control of EUS by application of a specific medicine developed by the scientists of the country is an achievement in itself. Several

such developmental activities in health management and disease control programme will give a new dimension to the aquaculture industry.

References

Ahmed, A.T.A. (1982). Skin myxoboliasis of major carp *Labeo rohita* in Bangladesh. Fish Health news, 2(4):1-11.

Bose, K.C. and A. K. Sinha (1985). Histopathology of *Clarias batrachus* (L) attributable to the intestinal cestode *Lytocestus indicus* (moghi). Proc. Nat. Acad. Sci. India. 5313 (3) : 226.

Chaudhuri, S.R., N.M. Chakravarty (1970). Studies on the myxosporidia (Protozoa : Sporozoa) from the food fishes of Bengal. Three new species from *Ophiocephalus punctatus* (Bloch). Acta Protozoal. B, 167, 173.

Dey, R. K., D. Kumar and B. K. Mishra (1988). Tissue level reactions in the Indian major carp, *Catla catla* (Ham.) due to myxobolous sp. Infection. Asian Fisheries Sciences, 1:117-122, 1988.

Dey, R. K. (1989). Histopathology of Argulosis in the Indian major carp, *Labeo rohita* (Hamilton). Proc. Natl. Sem. On `Forty Years of Aquaculture` in India : 7-9 Nov. 1989, pp. SVP/6.

Ganapati, P. N. and K. M. Rao (1962). Ecological and life history studies on a strigeid metacercaria (Trematode Diplostomatidae) from freshwater fishes of Andhra Pradesh. Parasitology, 52: 519-25, 1962.

Gopalakrishnan, V. (1961 a). Observations on infectious dropsy of Indian major carps and its experimental induction. J. Scient. Indl. Res. © 20: 357-58.

_____ (1961 b). Observations on a new epidermical eye disease affecting the Indian carpn *Catla catla* (Ham.) Ind. J. Fish. 8: 222-32.

_____ (1963). Controlling pests and diseases of cultured fishes. Indian livestk. 1(1) : 51-54.

_____ (1964). Recent development in the prevention and control of parasites of fishes cultured in Indian waters, Proc. Zool. Soc., Calcutta, 17: 95-100.

_____ (1966). Diseases and parasites of fishes in warm water pond in Asia and the Far East. FAO. World Symp. On warm-water fish pond culture, Rome 18-25 May. F.R. IX/R-4 25, 1966.

Gopalkrishnan, V. and P. D. Gupta (1960). An eye disease which causes mortality of the Catla catla (Ham.) Curr. Sci. 29(6):240.

Hora, S. L. and Pillay, T.V.R. (1962). Handbook on fish culture in the Indo-Pacific region. FAO Fish. Biol. Techn. Paper (14) : 204.

Jhingran, V.G. and R. V. S. Pullin (1985); revised 1988). A hatchery manual for the common Chinese and Indian major carps. Asian Development Bank and International Centre for Living Aquatic Resources Management, Manila, 191 p.

Jhingran, V. G. (1991). Text book of Fish & Fisheries of India, Third edition. Hindustan Publishing corporation (India). Delhi, 1991.

Karunasagar, I., P. K. M. Manzoor Ali; G. Jeyasekaran and I. Karunasagar. Ulcerative form fo Aeromonas hydrophila infection of *Catla catla*. Current Science, Dec.5, Vol. 55, No.23, pp. 1194-95, 1986.

Karamchandani, S. J. (1970). A new species of Myxobolus from the gill cavity of *Labeo bata* (Ham.) J. Ind. Fish. Soc. Ind. 2, 170-171.

Kamaraiah, P., V. K. Murgesan and P. v. Dehadrai (1971). A new record of a bacterium causing eye disease and mortality in *Channa maruatius* (Ham.). J. Inland, Fish. Soc. India, 9: 214-15.

Kumar, D., B. K. Mishra and R. K. Dey (1986 a). Dropsy of *Catla catla* (Ham.) caused by a mixed infection of *Aeromonas hydrophila* and Myxosporidian sp., Aquaculture Hungarica (Szarvas), V: 107-112.

Kumar, D., R. K. Dey and K. Kumar (1986 d). Preliminary observations of gill hyperplasia in common carp, *Cyprinus carpio* (L). Abst. In the Proc. Of 'International Symp. On Ichthyology', held at Dubronik, Yugoslavia, Sept., 1986.

Kumar, D., R. K. Dey, B.K. Mishra and K. Kumar(1987 a). Ulcerative deiseae in *Catla catla* (Ham.). Research Highlights in the First Indian Fisheries Forum, Dec.6-10, Mangalore, India.

Kumar, D., R. K. Dey, B. K. Mishra and K. Kumar (1987 b). Observations on the efficacy of malathion and potassium permanganate combination treatment in combating acute argulosis. Abstract. Publ. Proc. Of Nat. Seminar on Fish Aqua. In India, held at nagarjuna Unvi. (A.P.), 27-30 Dec. 1987.

Kumar, D., R. K. Dey, B. K. Mishra and K. Kumar (1989). Observation on some cases of ulcerative disease in Indian major carp, *Catla catla* (Hamilton), Proc. Nat. Sem. On 'Forty Years of freshwater Aquaculture in India', 7-9 Nov. 1989, pp. SVP/6.

Kumar, D. (1989). Epizootic ulcerative syndrome outbreak in India. Summer Inst. On Fish Dis. Dia. & health Man. In Freshwat. Aqua. Syst., 5-24 June, CIFA.

Meshwari, S.C. (1986). Occurrence of whirling disease in *Cirrhina mrigala* in Wardha. J. Bombay Nat. Hist. Soc. 83 (3) : 673.

Mishra, B. K. (1992). Annual report, CIFA, Kausalyaganga, Bhubaneswar.

Mukherjee, S.C., Suresh Chandra & Kausalay Nayak (1991). Studies on biochemical differences among isolates of *Aeromonas hydrophila* obtained from ulcerative disease affected fishes. Proc. Nat. Symp. On New Horizons in Fresh. Aqua., 23-25 Jan. 1991.

Mukherjee, S.C., Suresh Chandra, R. K. Dey and Gayatri Murjani (1991). Role of Aeromonas hydrophila in fish disease. Compnd. Annual Conf. Of Indian Assoc. Vet. Pathologist, Ranchi, 24-26, Aug., 1991, pp. 21.

Mukherjee, S.C. (1992). Mass mortality of silver carp due to Staphylococus aureus. Annual report, CIFA.

Mukherjee, S. C. (1992). Dropsy due to *A. hydrophila* in conjection with malnutrition in fishes. Annual report, CIFA.

Mukherjee, S.C. (1994). Epizootic ulcerative syndrome in India. Man. Train. Prog. On Fish. Dis. Diag. And Cont. pp.5-13.

Mukherjee, S.C., B.B. Sahu, Gayatri Murjani and P. Patnaik (1994). Mass mortality in rohu spawn due to Edwarsiellosis. Accepted in Nat. Sem. On Aqua. Ani. Healt. At Univ. of Kerala, Tiruvanathapuram, 15-17 March, 1995.

Nayak, K. and S. C. Mukherjee (1994). Drug resistance of *Aeromonas hydrophila* strains isolated from freshwater and brackishwater fishes. Fishing Chimes, Sept. 1994, pp. 41-42.

Pal, R. N. and A. K. Ghosh (1975). An effective method of controlling tail and fin rot in Indian major carps. J. Inland Fish. Soc. 7 : 98-99.

Pal, R. N. and S. D. Tripathi (1970). Use of terramycin for fish diseases in carp and catfish culture in Indian waters. J. Inland Fish. Soc. 10: 166-68.

Senappa, D., L. Manohar (1980). Myxobolus vanivilasac n.s. parasitic in *Cirrhina mrigala* (Ham.). Proc. Ind. Acad. Sci., 89, 485-91.

Senaullah, M., A. T. T. Ahmed (1980). Gill myxoboliasis of major carp Bangladesh. J. Fish. Dis. 3, 349-354.

Shah, K. L. and Tyagi, S.C. (1986). An eye disease in silver carp *Hypophthalmichthys molitrix* held in Tropical ponds associated the bacterium *Staphylococcus aureus*. Aquaculture, 55(1):1-4.

Shrivastava, G.C. and R.C. Shrivastava (1977 a). Host range of *Seprolegnia ferox* (Gnith), Thuret on certain freshwater teleost, Curr. Sci. 46-7, 1977.

_____ (1977 b). Ability of Saprolegniassis fungi to parasities colisa fasciatus (BL) geobias., 4:31-29, 1977.