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Full Length Research Paper

Histopathological changes in the gills of naturally-infected *Capoeta aculeata* (Cuvier and Valenciennes, 1844) with parasites

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Histopathological changes in gills of a native fish *Capoeta aculeata*, naturally-infected with parasites were studied. The specimens (15.5 to 22.8 cm) were collected from Choghakhor lagoon in West Iran. 35 (11%) of the total 318 studied fishes were infected with gill parasites. Overall, six protozoan and metazoan parasite species were collected from fishes including *Ichthyophthirius multifiliis*, *Trichodina* sp., *Myxobolus musayevi*, *Dactylogyrus extensus*, *Gyrodactylus* sp. and Copepod stage of *Lerneae cyprinacea.* The gills of infected fish were fixed and processed for routine histological investigations. Histopathological changes and tissue reactions included hyperplasia, congestion and mucous cell proliferation of the gill epithelium and damaged primary and secondary lamellae. Histopathological changes induced by the parasites adversely affected the proper functioning of the gills of the host fish.

Key words: Gill parasites, histopathology, *Capoeta aculeata*, Choghakhor lagoon.

INTRODUCTION

Gill parasitic are common on cultured and wild fish, and there is a vast literature available for the taxonomy and host ranges. Many of these species have long been recognized to have the potential to affect the growth, fecundity and survival of hosts (Johnson et al., 1996). Moreover, extensive tissue damage resulting from the feeding and attachment of these parasites has been reported in several species of fish (Abdelhalim, 1990). In addition, it was suggested that lesions due to attachment and feeding of parasites may be secondarily infected with fungi and bacteria (Jalali, 1998). Hyperplasia of the epithelial cells and subsequent lamellar fusion, goblet cell proliferation as well as the migration of eosinophilic granular cells (EGCs) to gills of fishes infected with these parasites has been recorded.

Different parasitic surveys on a range of native freshwater fish species had been done in Iran since 1949 (Bychowsky, 1949; Eslami et al., 1979; Fadaei et al., 2001; Barzegar and Jalali, 2004; Barzegar et al., 2008; Shamsi et al., 2009; Raissy et al., 2011). However, histopathological impact of the parasites on their hosts remains to be determined. The aim of this study was to determine the host-parasite interaction, with specific reference to the pathology induced by gill parasites on a naturally-infected native fish inhabiting Choghakhor lagoon.

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MATERIALS AND METHODS

Fishes were caught by gillnets, bagnets and hooks by local fishermen from the Choghakhor lagoon and kept alive in lagoon water. After the capture, live fishes were immediately transported to the laboratory, where the fish were anesthetized by eugenol and killed instantly. The specimens were studied in a short time after arrival. The gills were completely removed from the sacrificed fishes and microscopic examination was carried out under the dissecting microscope (Nikon, USA). Identification of parasites was carried out in accordance with the keys given by Gussev (1985), Lom and Dykova (1992) and Jalali (1998). Prevalence, intensity and abundance of infection were recorded. The gill specimens were fixed in 10% neutral formalin (Merck, Germany), then were serially sectioned at about 5 µM on a rotary microtome (LEITZ 1512, USA), stained with the haematoxylin-eosin and observed under a light microscope (Roberts, 2001). In this study, only fishes heavily infected were selected. For comparative purposes, the gills from uninfected fishes were also processed simultaneously.

Table 1. Prevalence, intensity and abundance of parasites.

Parasite	Number of parasitized fish	Prevalence (%)	Number of parasites collected	Intensity of parasitism		Abundance
				Range	Mean	
Ichthyophthirius multifiliis	34	10.6	126	1-24	3.7	0.78
Trichodina sp.	12	3.8	30	1-12	2.5	0.09
Myxobolus musayevi	2	0.62	3	1-2	1.5	0.009
Dactylogyrus extensus	8	2.5	34	1-17	4.2	0.1
Gyrodactylus sp.	32	10	107	1-14	3.3	0.33
Copepodid stage of *Lernaea cyprinacea*	7	2.2	12	1-3	1.7	0.03
Total	35	11	312	1-24	3.2	0.98

RESULTS

A total number of 318 fish specimens, including 170 males and 148 females were studied. Fishes with the following biometric characteristics were randomly selected: total length was 15.5 to 22.8 (mean = 18.8 cm), weight was 98 to 311 g (mean = 199.3 g), and age was 1 to 3 (mean = 2.1 years). 35 fishes (11%) were found to be infected with several species of protozoan and metazoan parasites including *Ichthyophthirius multifiliis*, *Trichodina* sp., *Myxobolus musayevi*, *Dactylogyrus extensus*, *Gyrodactylus* sp. and Copepod stage of *Lerneae cyprinacea.* The collected parasites, intensity, prevalence and abundance are listed in Table 1. In parasitized gills, enhanced mucous production, congestion, haemorrhages and telangiectasia in lamella were encountered. Attachment of parasite resulted in a cavity in gill tissue not only at the point of attachment, but under the entire area occupied by the parasite. The compressed lamellar epithelium was noted in having the following features: a lower number of mucous and glandular secretary cells, an increase in infiltrating cells compared to those observed in neighboring filaments and epithelial cells were markedly hyperplasic. Histopathological changes in gills are shown in Figures1 and 2.

DISCUSSION

Parasites found in this study, such as Monogenea or Ciliophora, fed on fish gill epithelium by destruction of the cells or by ingesting blood from the ruptured blood vessels. Monogeneans attach to the epithelium of the primary lamellae by means of anchors and cause cell destruction and also bleeding at the time of attachment. The blood expelled from this would be fed by the parasite. Some parasites secrete exogenous enzymes and digestion take place besides the gill filaments of the host fish. This was shown by the higher number of cell nuclei within the gut of gill parasites in the gill histological sections (Vinobaba, 2007). The surface of the gill epithelial cells seemed like a cavity in some places, which is probably due to the enzymatic activity of *Ichthyophthirius*. Attachment and activity of some parasites can lead to bacterial or fungal secondary infection and causes mass mortality in cultured and wild situation. Adhesions between gill filaments were observed in many specimens and consequently fish respiration will be impaired, which results in reduced feeding, weight loss and general deterioration of health. The severity of respiratory damage is directly proportional to the number of parasite on the gills. When their intensity increases, the gill damage may be serious and shows pronounced impact of the histology and lead to mortality. Decreasing the body weight and condition factor, sever changes in osmoregulation or respiratory dysfunction and finally death may be observed in infection with gill parasites.

Gill epithelial cells are mechanically injured by the hooks of monogenean parasites and copepods. Buchman (1998) also showed strong activities of esterases, amino-peptidases and phosphatases (alkaline and acid) in the intestine of *Gyrodactylus derjavivi*. Fish epithelial cells are able to produce Interleukin-1 (IL-1) or Interleukin-1 factor following infection with *Gyrodactylus*. IL-1 has different roles, including inducing hyperplasia, activating macro-phages and potentiating the response of fish lymphocytes, and it is also known to induce mucus secretion (Balm et al., 1995). Parasite development within host epithelial tissues initiates localized leukocytic infiltrations, although the relationship between these responses and host resistance is uncertain, and whether or not leukocyte responses play a role in protective immunity is unclear (Cross, 1994).

The histopathology explained in this study for the fish species studied from Choghakhor lagoon is almost similar to the Atlantic salmon infected with *Ergasilus labracis* that

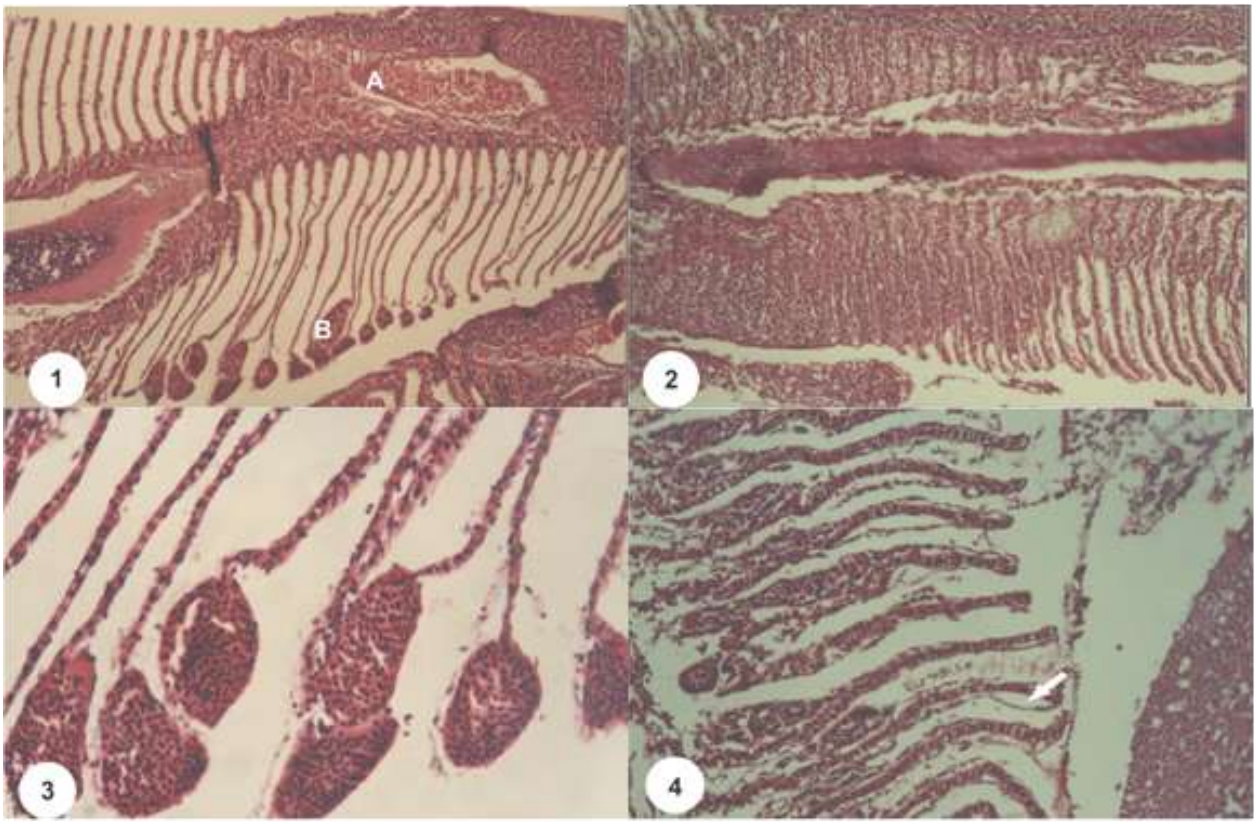

Figure 1. 1A, Congestion; 1B, Telangiectasia in secondary lamellae (70 X); 2, massive hyperplasia in epithelial cells of secondary lamella (163 X); 3, Telangiectasia in secondary lamellae (238 X); 4, detachment of epithelial cells in secondary lamella (137.5 X).

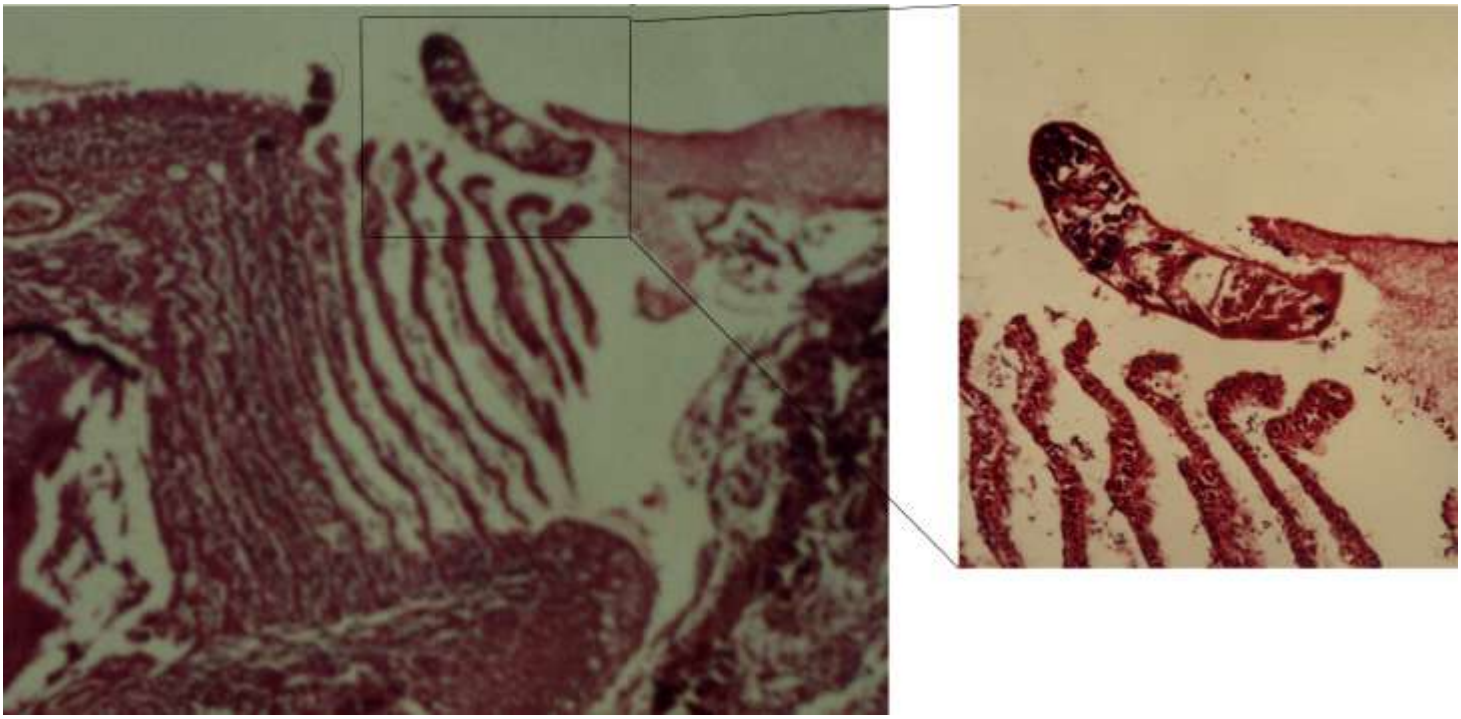

Figure 2. Section of *Gyrodactylus* sp. in gill with congestion and hyperplasia (44 and 150 X).

was characterized by severe gill hyperplasia and high levels of mortality (Hogans, 1989).

Conclusion

The major features of parasitic infections on the gill filaments of the fish in this study or similar studies mostly include destruction of the gill filaments and lamellae, exerted by feeding of the parasite and the resultant hyperplasia and thickening of the epithelial cells reducing the surface area for effective respiration. Such hyperplasia can severely stress the fish, or can even lead to death from lack of oxygen. Gill damage could result in loss of gill surface area for respiration, which would lead to suffocation particularly at high water temperatures. This could also lead to reduced growth and secondary infection which affects the survival of the fish. The osmoregulatory failure might also be important since the piercing of the parasite exposes the surface of the host to natural environment. According to the results, the histopathological changes induced by the infections of parasites would adversely affect the proper functioning of the gills of these infected fish.

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