Stress indices of Grass carp, *Ceteopharyngodon idella*, (Cuvier and Valenciennes, 1884) change in response to Monogenean parasites pollution, *Gyrodactylus* spp. and *Dactylogyrus* spp.

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Abstract The aim of this research was study of stress indices in response to Monogenean infection in Grass carp, *Ceteopharyngodon idella*. In this regard, some stress indices were measured in two adult groups of Grass carp including healthy and infected fish. According to our results, the values of cortisol and glucose and lactate were significantly higher in infected fishes than healthy individuals. Elevation of cortisol and glucose demonstrated the existence of stressful condition caused by parasitic infection and demands for energy for adaptation. In conclusion, our results showed that Monogenean infection by *Gyrodactylus* spp. and *Dactylogyrus* spp. affects health condition of Grass carp through alternation of stress components.

Keywords Stress indices · Monogenean infection · Grass carp

Introduction

Under natural condition, fish are exposed to various types of environmental stressors that understanding of the stress responses may help to know ecosystem condition and

subsequent managements. Diseases in particular parasitic types are of prevalent threats for natural aquatic ecosystems (Kabata 1985). Monogeneans with about 100 families are a group of parasites which are commonly found on the gills, skin or fins of both fresh and salt water fishes. During life cycle, Most of Monogenea are host-specific and attached to tissue surface by a series of hooks and fed on dermal mucus and gill debris. In fact, some adult monogenean will remain permanently attached to a single site on the host. *Dactylogyrus* and *Gyrodactylus* are of the most widespread monogenean parasites of the fishes. *Dactylogyrus* is usually attached to the gills of freshwater fishes. It reproduces by laying eggs, which are often resistant to chemical treatment (Petrushevski and Shulman 1961; Smith 1972; Bakke et al. 1990; Cognetti-Varriale et al. 1992; Cunningham et al. 1995a, b; Cecchini et al. 1998). The blood parameters of a fish species are true indicators of health status (Serpunin and Likhatchyova 1998). Moreover, haematological tests and analysis of serum constituents have showed useful information in detection and diagnosis of metabolic disturbances and diseases in fishes (Aldrin et al. 1982). The grass carp, *Ceteopharyngodon idella* is one of the main produced species of aquaculture in many countries including Iran. The aim of this study was to investigate the effects of Monogenean infection on stress indices of Grass carp. Such study can help to understand he mode of action of these parasites in haematological level.

Materials and methods

Ten Adult healthy and 10 Monogenean infected Grass carp were collected from a carp culture farm, located in Guilan province, Iran, and kept separately in plastic tanks. Blood samples for haematological analyses were taken from the

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caudal vein and collected in a heparinized tube and then stored in a polyethylene cool bags until analyzed. Plasma cortisol was measured by RIA. Plasma glucose (mMol/L. serum) was assayed by analysis commercial kit through colorimetric method using an Auto-analyser Technician. Lactate concentrations were determined by reduction of nicotinamide adenine dinucleotide with lactate dehydrogenase (Marbach and Weil 1967; Carey and McCormick 1998). The SPSS software was used for data analysis. The normal distribution of data was investigated by Kolmogorov–Smirnov test. Then, Independent Samples *t* test was employed to compare the means between healthy and infected fish.

Results

According to our results, there were significant differences between infected and non-infected grass carps in terms of cortisol, glucose and lactate levels ($P < 0.05$). In this regard, the values of cortisol (Fig. 1), glucose (Fig. 2) and lactate (Fig. 3) were significantly ($P < 0.05$) higher in monogenean infected fishes compared to healthy individuals.

Discussion

It well known that the haematological factors could be used as biomarkers of health status in aquatic animals including fish. Monogenean is a group of parasites that have adverse effect of fish health in aquatic ecosystems. Until now, many studies were conducted regarding the histopathological effects of Monogeneans on fish. But, there were rare information about their impacts on stress indices. In the present study the blood parameters including cortisol, glucose and lactate were investigated in two experimental groups including healthy fish and infected individuals.

Fig. 1 Comparison of cortisol concentration between healthy and infected grass carp. Different letters indicate significant differences ($P < 0.05$)

Fig. 2 Comparison of glucose concentration between healthy and infected grass carp. Different letters indicate significant differences ($P < 0.05$)

Fig. 3 Comparison of lactate concentration between healthy and infected grass carp. Different letters indicate significant differences ($P < 0.05$)

According to results, the higher values of cortisol, glucose and lactate were observed in infected fish compared to healthy individuals. In the teleosts, it is well recognized that the stressor stimulates the hypothalamic–pituitary–interrenal (HPI) axis to release cortisol from the interrenal tissue as a primary response to stress. Afterward, cortisol mediates the stress-induced hyperglycemia (increasing of glucose concentration in blood) that is thought to be crucial for supporting the increased energy demand associated with stress (Mazeaud and Mazeaud 1981; Mommsen et al. 1999; Randall and Perry 1992; Wendelaar Bonga 1997; Saplosky et al. 2000; Vijayan et al. 1997). The elevation of cortisol and glucose levels in response to parasitic pollution likely return to stressful condition caused by monogenean parasites. In the present study, lactate levels were apparently higher in infected grass carps compared to healthy fish. In animals, lactate is constantly produced from pyruvate via the enzyme lactate dehydrogenase in a process of fermentation during normal metabolism and exercise. Lactate accumulation occurs almost when the oxygen supply can not meet demands for oxygen i.e. in an anaerobic condition. Likely, gill damages by monogenea could

disturb oxygen transfer in grass carp gill. Therefore, It seems that the elevated levels of lactate are a response to anaerobic condition caused by infection.

References

- Aldrin JF, Messenger JL, Laurencin FB (1982) La biochimie clinique en aquaculture. Intérêt et perspective. CNEXO Actes Colloq 14:291–326
- Bakke TA, Jansen PA, Hansen LP (1990) Differences in the host resistance of *Atlantic salmon*, *Salmo salar* L., stocks to the monogenean *Gyrodactylus salaris* Malmberg, 1957. J Fish Biol 37:577–587
- Carey JB, McCormick SD (1998) Atlantic salmon smolts are more responsive to an acute handling and confinement stress than parr. Aquaculture 168:237–253
- Cecchini S, Saroglia M, Berni P, Cognetti-Varriale AM (1998) Influence of temperature on the life cycle of *Diplectanum aequans* (Monogenea, Diplectanidae), parasitic on sea bass, *Dicentrarchus labrax* (L.). J Fish Dis 21:73–75
- Cognetti-Varriale AM, Cecchini S, Saroglia M (1992) Therapeutic trials against *Diplectanum aequans* (Monogenea), parasite of sea bass (*Dicentrarchus labrax*, L.) in intensive farming. Bull Eur Assoc Fish Pathol 12:204–206
- Cunningham CO, McGillivray DM, MacKenzie K, Melvin WT (1995a) Identification of *Gyrodactylus* (Monogenea) species parasitizing salmonid fish using DNA probes. J Fish Dis 18:539–544
- Cunningham CO, McGillivray DM, MacKenzie K, Melvin WT (1995b) Discrimination between *Gyrodactylus salaris*, *G. derjavini*, *G. truttae* (Platyhelminthes, Monogenea) using restriction fragment length polymorphisms, and an oligonucleotide probe within the small subunit ribosomal RNA gene. Parasitology 111:87–94
- Kabata Z (1985) Parasites and diseases of fish cultured in the tropics. Taylor and Francis Ltd, London, p 318
- Marbach EP, Weil MH (1967) Rapid enzymatic measurement of blood lactate and pyruvate. Clin Chem 13:314
- Mazeaud MM, Mazeaud F (1981) Adrenergic responses to stress in fish. In: Pickering AD (ed) Stress and fish. Academic Press, New York, pp 49–75
- Mommsen TP, Vijayan MM, Moon TW (1999) Cortisol in teleosts: dynamics, mechanisms of action, and metabolic regulation. Rev Fish Biol Fish 9:211–268
- Petrushevski GK, Shulman SS (1961) The parasitic diseases of fishes in the natural waters of the USSR. In: Dogiel VA, Petrushevski GK, Polyanski YuI (eds) Parasitology of fishes. Oliver and Boyd, Edinburgh, pp 299–319
- Randall DJ, Perry SE (1992) Catecholamines. In: Hoar WS, Randall DJ (eds) Fish physiology, vol 12B. Academic Press, New York, pp 255–300
- Saplosky RM, Romero LM, Munck AU (2000) How do glucocorticoids influence stress response? Integrative, permissive, suppressive, stimulatory, and preparative actions. Endocr Rev 21:55–89
- Serpunin GG, Likhatchyova OA (1998) Use of the ichthyohaematological studies in ecological monitoring of the reservoirs. Acta Vet Brno 67:339–345
- Smith JW (1972) The blood flukes (Digenea: Sanguinicolidae and Spirorchidae) of cold blooded vertebrates and some comparison with the schistosomes. Helminthol Abstr 41A:161–204
- Vijayan MM, Pereira CE, Grau G, Iwama GK (1997) Metabolic responses associated with confinement stress in tilapia: the role of cortisol. Comp Biochem Physiol 116:89–95
- Wendelaar Bonga SE (1997) The stress response in fish. Physiol Rev 77:591–625