Parasitic infection alters haematology and immunity parameters of common carp, *Cyprinus carpio*, Linnaeus, 1758

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Abstract The present study was conducted to investigate the effects of parasite infection on haematological parameters of common carp, *Cyprinus carpio*. To this end, fish with same age were sampled from a warm water fish farm. After fish sampling, fish were transferred to lab for parasite study. Parasite incidence percent and density were calculated for two population carps. After parasite study, to investigate the haematological parameters, the blood sampling was carried out from two group fish i.e. infected ($n = 20$) and non-infected fish ($n = 20$). According our results, totally three parasite species were identified including *Dactylogyrus* sp., *Trichodina* sp. and *Lernaea cyprinacea*. Significant differences were observed between infected and non-infected fish ($P < 0.05$). In this regard, the values of haematocrit, haemoglobin and red blood cell were lower in infected fish than healthy individuals ($P < 0.05$). In contrast, number of white blood cells

(WBCs) were higher in infected fish compared to non-infected fish ($P < 0.05$). In conclusion, our study reveals that the parasite infection was responsible for altering the haematology of common carp. Increased number of WBC may be in relation to the defense mechanism and immunological responses against parasites.

Keywords Haematology · Immunity · Parasite · Common carp

Introduction

Parasites are of the important pathogens that affect adversely biological aspects of fish and cause numerous pathological damages to variety of wild and farmed fishes including histological damages, reductions in growth, health and meat quality of fish. Haematological parameters are used as indicators of fish health in relation to diseases and surrounding water alternation (Garcia-Navarro 1994; Cataldi et al. 1998; Serpunin and Likhatchyova 1998; Ranzani-Paiva et al. 1999). The common carp (*Cyprinus carpio*) is a widespread freshwater fish of eutrophic waters in lakes and large rivers in Europe and Asia. The common carp, *Cyprinus carpio*, is apparently the most widely geographically distributed fish species in Iran and other region of world. Owing to its adaptation to a wide range of climatic and geographical conditions, a substantial number of almost all major taxa of parasites have been found in wild and domestic carp. It is usually known that external parasites constitute the largest group of pathogenic organisms in warm water fish (Snieszko and Axelrod 1971). The presence of parasites is detrimental for a fish population and may cause high mortality, weight losses, and reduced fecundity on both cultured and wild fish species especially

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in waters contaminated with industrial and urban pollutants (Grabda 1991). Poor water quality and lack of nutrition cause parasitic disease outbreaks (Cengizler et al. 2001; Chisholm et al. 2001; Edema et al. 2008). To the best knowledge of the authors there are few studies on haematological alternations in relation to parasitism. Therefore, in the present study, we investigated alternations in haematological and immunological parameters of common carp in relation to parasite pollution. He assayed parameters were: haematocrit percent, haemoglobin concentration, red blood cell counts, white blood cell counts and mean corpuscular volume.

Materials and methods

60 common carps were captured using nets from a warm water fish pond located in Guilan Province, Iran. After capture, they were delivered alive to the lab for parasite investigations. Fish were initially examined for the presence of any parasites visible to naked eye. After that, wet mounts were prepared from different points of infected fish body including gill and skin. After that, wet mounts were stained by carmine alum, washed in acid alcohol, dehydrated in an alcohol series, cleared in xylol, and mounted in Canada balsam. At the end, wet mounts were examined and photographed under light microscope and stereomicroscope for the identification of parasites.

The quantitative indices of parasite populations were calculated according to following formula (Bush et al. 1997):

- Incidence percent = (total number infected host / total number of examined host) $\times$ 100
- Mean abundance = total number of individuals of a particular parasite / total number of hosts of that examined

To investigate haematological parameters, the blood samples were taken from the caudal vein of fish using a heparinized syringe. Immediately after blood sampling, the blood samples were delivered to lab for RBCs, WBCs, Hct and Hb assays.

The microhaematocrit capillary tubes were used for measurement of Hct values according to Rehulka (2003). The Hb values were determined by Cyanmethemoglobin according to Klontz (1994). RBC and WBC values were determined with chamber method using Neubauers haemocytometer (Drabkin 1945).

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 means between infected and non-infected fish. Data are presented as mean $\pm$ SD.

Results

The parasites of common carp are shown in Table 1. In infected fish, totally three parasite species were identified including *Dactylogyrus* sp., *Trichodina* sp. and *Lernaea cyprinacea*. The values of prevalence, intensity and abundance of parasites have included in Table 1 as well. Significant differences were observed between infected and non-infected fish ($P < 0.05$). In this regard, the values of haematocrit (Fig. 1), haemoglobin (Fig. 2) and red blood cell (RBC) (Fig. 3) were lower in infected fish than healthy

Table 1 Parasitic fauna of infected common carp

Parasites	Mean abundance	Incidence percent
<i>Dactylogyrus</i> sp.	3.5 $\pm$ 2	25 $\pm$ 8
<i>Trichodina</i> sp.	6.5 $\pm$ 2.5	82.2 $\pm$ 15
<i>Lernaea cyprinacea</i>	4.2 $\pm$ 1.5	28 $\pm$ 6

Fig. 1 Comparison of haematocrit between infected and non-infected common carp. Different letters indicate significant differences ($P < 0.05$)

Fig. 2 Comparison of haemoglobin between infected and non-infected common carp. Different letters indicate significant differences ($P < 0.05$)

Fig. 3 Comparison of red blood cells (RBCs) between infected and non-infected common carp. Different letters indicate significant differences ($P < 0.05$)

Fig. 4 Comparison of white blood cells (WBCs) between infected and non-infected common carp. Different letters indicate significant differences ($P < 0.05$)

individuals ($P < 0.05$). In contrast, number of WBCs were higher in infected fish compared to non-infected fish (Fig. 4, $P < 0.05$).

Discussion

In the present study, three kinds of parasites i.e. *Dactylogyrus* sp., *Trichodina* sp. and *Lernaea cyprinacea* were identified in infected common carps. *Dactylogyrus* is a genus of the Dactylogyridae family. They are commonly known as gill parasite like other monogeneans, *Dactylogyrus* only has one host required to complete its life cycle and particularly selects freshwater fish such as carp as host. *Trichodina* is a genus of ciliate protists that is parasitic on aquatic animals, particularly fish. Also, *Lernaea cyprinacea* (Anchor worm) is a copepod parasite that infects many freshwater fishes including common carp. *Lernaea* creates skin damages, reduces growth and osmoregulation ability, and also influences behavior and decreases fish resistance against stressful condition. Our results in the present study showed that

parasitic infection alters haematological parameters of common carp. Parasites caused reductions in RBCs, Hb and Hct. some studies demonstrated a reduction in RBC, Hb and Hct in relation to parasitism (Martins et al. 2004). Nevertheless, other studies showed that parasites as a stressor stimulate the primary stages of stress and affect haematocrit. As well as, parasitic infection stimulates releasing catecholamine, which can mobilize red blood cells from spleen (Wells and Webber 1990) or induce red blood cell swelling as a result of fluid shift into the intracellular compartment (Chiocchia and Motais 1989). In current study, the values of WBCs were higher in infected fish compared to healthy individuals. The elevation of serum WBCs have been recognized well as immune response to variety of infections. Thus, the elevation of WBCs in infected common carp may be a response of cellular immune system to parasitic infection. WBCs play a great role during infestation by stimulating the haemopoietic tissues and the immune system by producing antibodies and chemical substances working as defense against infection (Lebelo et al. 2001). In conclusion, our study reveals that the parasite infection was responsible for altering the haematology of Common carp. Increased number of WBC may be in relation to the defense mechanism and immunological responses against parasites.

Compliance with ethical standards

Conflict of interest None.

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