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Effect of the infection of the mugilid fish *Planiliza subviridis* with the copepod *Ergasilus rostralis*: A haematological study

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Abstract

A total of 83 specimens of *Planiliza subviridis* were collected from Khor Al-Zubair lagoon, northwest Arab Gulf, Iraq. These fishes were found infected with the copepod *Ergasilus rostralis* Ho, Javarajan & Radhakrishnan, 1992. Blood parameters: total leukocyte count (WBCs), total red blood cells (RBCs), haemoglobin content (Hb%) and haematocrit volume (PCV) were investigated for lightly (1-5 parasites/fish), mildly (6-10 parasites/fish) and heavily (> 10 parasites/fish) infected fish groups in comparison with uninfected fishes. Uninfected fishes had the highest values of all blood parameters, except WBCs. Hb%, PCV and RBCs significantly decreased in all infected groups when compared with the uninfected group. WBCs significantly increased in all infected fish groups in comparison with the uninfected fishes. WBCs insignificantly decreased in heavily infected group when compared with mildly infected fishes.

Keywords: *Planiliza subviridis*, Copepoda, *Ergasilus rostralis*, Haematology, Khor Al-Zubair Lagoon, Iraq

1. Introduction

Greenback grey mullet *Planiliza subviridis* (Valenciennes, 1836) belongs to the family Mugilidae (Froese & Pauly, 2023), of the order Mugiliformes (GBIF, 2023). This family is distributed in Indo-Pacific region, covering Red Sea to Samoa, north to Japan and South Africa, as well as the Arab Gulf region. They are demersal and catadromous species found in marine, fresh and brackish waters (Fitriah et al., 2020).

Fishes play as hosts to a wide variety of parasites (Lieke et al., 2020). Fish parasites may be harmful when fishes are weakened by outside stresses (Meyer, 1979). Fish parasites can cause mortalities in both wild and cultured fishes, but Overstreet (1990) believed that

infections which cause mortalities in wild fishes are often overlooked because the hosts are preyed upon before or soon after their death. According to Mhaisen (2023), *P. subviridis* in Iraq is infected with 47 different parasite species, which included seven species of *Ergasilus*.

Ergasilus rostralis was described, as a new species by Ho et al. (1992) from the coastal fishes of Kerala, India. This copepod belongs to the family Ergaslidae of the order Cyclopoda (WoRMS, 2023). It was recorded for the first time in Iraq from gills of *Planiliza abu* (reported as *Liza abu*) from the Shatt Al-Arab River, Basrah Province by Ho et al. (1996). According to Mhaisen (2023), this copepod is known to infect 20 fresh and marine fish species in Iraq.

Blood parameters can be considered as indicators of the capacity to transport oxygen and may also provide additional information about the host's health and immune status, which are important indicators of changes to the host (Ballarin et al., 2004; Wells et al., 2005; Tavares-Dias & Moraes, 2007; Ananda Raja et al., 2020; Sivaramakrishnan et al., 2023). Haematological examination is one of methods commonly used to evaluate fish health and physiological status (Ivanc et al., 2005; Clauss et al., 2008; Grant, 2015; Docan et al., 2018; Fazio, 2019; Ananda Raja et al., 2020; Sivaramakrishnan et al., 2023).

In Iraq, some works were done on different haematological effects, caused by different parasite species, on their fish hosts. Among the notable ones are those done on the following fish species: *Arius bilineatus* by Jori & Mohamad (2008), *Ctenopharyngodon idella* by Jori et al. (2008), *Cyprinus carpio* by Al-Tamimi et al. (2001), Ali & Ansari (2012), Jarallah (2012), Ahmed & Ali (2013) and Rasool (2017), *Heteropneustes fossilis* by Al-Salim & Ali (2003), *Hypophthalmichthys molitrix* by Jori et al. (2008), *P. abu*, which was reported as *L. abu*, by Al-Salim & Jori (2002a, b, c), *P. subviridis*, which was also reported as *Liza subviridis* (except for Al-Daraji et al., 2023 who reported this fish as *P. subviridis*) by Al-Salim & Jori (2002a, b) and Al-Daraji et al. (2023) and *Silurus triostegus* by Al-Abood (1992), Jori (2006) and Bilal (2016). So, the current study was carried out to evaluate the infection of *E. rostralis* on health status of *P. subviridis* by measuring some haematological parameters for infected and uninfected fishes.

2. Materials and methods

Eighty-three specimens of *P. subviridis* were collected from Khor Al-Zubair lagoon (N: 30º08´16", E: 47º54´31"), northwest Arab Gulf during March, April and May 1993. The study period was restricted to spring season to avoid the seasonal effects on blood parameters and because the peak of ergasilid infection usually occurs during this season (Paperna, 1980). The selected fish total length ranged from 14 to 18 cm. Fishes were identified according to Coad (2010). They were gently handled to avoid stress and were immediately sacrificed by pithing with a fine needle. After completion of blood withdrawal, fishes were examined for parasites by using light dissecting microscope, then dissected out and sexed.

Freshly dead fishes were placed on their backs in a V-shaped trough. Blood was withdrawn by cardiac puncture using a 2 cm3 sterile plastic syringe equipped with 20 gauge x 38 mm hypodermic needle according to Smith et al. (1952) and Ananda Raja et al. (2020). The blood sampling site was dried with a clean dry tissue paper before blood collection to avoid contamination with mucus and water. After needle detached from the syringe, the blood was placed in clean, dry marked tubes according to Blaxhall & Dasley (1973).

At the field, the obtained tubes were tightly closed and well shacked to prevent clot formation. They were transferred to the laboratory in iced boxes for measuring total leukocyte count (WBCs), total red blood cells (RBCs), haemoglobin content (Hb%) and haematocrit volume (PCV) according to Blaxhall & Daisley (1973). The obtained results (mean and

standard error) were analysed, where the T-test was applied to get the significant values ($P \leq 0.05$) according to Dytham (2011).

The detected parasitic copepods were counted, fixed, preserved and then identified as E. rostralis according to Ho et al. (1992). The infected fishes were categorized into three groups as with light infection (1-5 parasite specimens), mild infection (6-10 specimens) and heavy infection (more than 10 specimens).

A total of 17 lightly infected fishes, 30 mildly infected fishes, 19 heavily infected fishes and 17 uninfected fishes were subjected to blood analysis. After their dissection, all fishes were divided into males and females.

3. Results

The results of haemoglobin concentration, haematocrit value as well as erythrocyte and leukocyte counts for all infected and uninfected fishes are presented in Table (1). Haemoglobin concentration tends to coincide with haematocrit values among all fish groups and their sexes (Table 2).

Healthy fishes had the highest values of all blood parameters, except WBCs, Hb%, PCV and RBCs, dropped down sharply and significantly ($P \leq 0.05$) in all infected groups when compared with the uninfected fishes. WBCs increased significantly ($P \leq 0.05$) in all infected fish groups in comparison with uninfected fishes. WBCs decreased in heavily infected group when compared with mildly infected fishes. However, this decline was not statistically significant.

Table 1. Haematological parameters of healthy and infected *P. subviridis* with E. rostralis (Mean ± S.E.).

Fish groups	Fish sex	Number of fishes examined	Fish total length (cm)	Haemoglobin concentration (g/100 ml)	Haematocrit value (%)	RBCs count (x 10/mm3)	WBCs count (x 10/mm3)
Lightly infected	Males	6	17.3 ± 0.68	8.9 ± 0.86	28.2 ± 2.09	1.18 ± 0.21	185 ± 0.53
	Females	11	17.7 ± 0.20	8.9 ± 0.92	26.7 ± 1.87	1.06 ± 0.36	177 ± 0.66
Mildly infected	Males	13	16.2 ± 1.90	5.8 ± 0.67	23.4 ± 0.98	0.96 ± 0.87	248 ± 0.42
	Females	17	16.9 ± 0.82	5.8 ± 1.83	20.8 ± 1.12	0.90 ± 0.72	233 ± 0.83
Heavily infected	Males	8	16.0 ± 1.27	5.3 ± 0.52	16.6 ± 0.83	0.89 ± 0.14	227 ± 0.30
	Females	11	16.6 ± 1.33	5.1 ± 0.87	16.3 ± 0.62	0.84 ± 0.26	224 ± 0.64
Uninfected	Males	8	16.7 ± 1.53	9.4 ± 1.35	33.1 ± 1.31	1.36 ± 0.38	136 ± 0.61
	Females	9	17.3 ± 1.08	9.1 ± 1.42	32.2 ± 1.51	1.34 ± 0.26	134 ± 0.98

Table 2. The correlation coefficient value (r) between haemoglobin concentration and haematocrit values among fish groups and sexes of *P. subviridis* infected with *E. rostralis*.

Fish groups	Fish sex	Correlation coefficient (r)
Lightly infected	Males	0.801
	Females	0.844
Mildly infected	Males	0.877
	Females	0.903
Heavily infected	Males	0.786
	Females	0.836
Uninfected	Males	0.805
	Females	0.850

4. Discussion

Values of haemoglobin concentration of healthy fishes were high (Table 1). This case comes in agreement with Putnam & Freel (1978) who demonstrated that pelagic fish species (such as *P. subviridis*), have a higher haemoglobin concentration in comparison with the benthic fish species (Sandeep et al., 2022; Sivaramakrishnan et al., 2022). Mavares & Pérez (1984) stated that fish species, which live in a more variable environment, possess more haemoglobin content. The high haemoglobin content of *P. subviridis* of the present study may be attributed to the feeding activity and feeding intensity, which are noticed in a high rate in this fish species during spring season (Al-Hisnawi, 1990; Sandeep et al., 2022; Sivaramakrishnan et al., 2022). Previously, the same result was obtained by Al-Hassan & Abood (1988) in the mugilid fish *P. dussumieri*.

Kabata et al. (1970) stated that blood-feeding parasites could be expected to exert a significant influence on the composition and volume of host blood where their influence is usually expressed in changes in the blood picture. There is no agreement among the scientists who studied the feeding habits of ergasilid parasites. Wilson (1911) suggested that ergasilid species feed on host blood, but according to Neuhaus (1929), some blood is taken and lost on bleeding when the parasite was feeding on gill tissues. Kabata et al. (1970) concluded that ergasilids live on mixed diet of blood and integument cells.

Paperna (1980) reported loss of weight and growth retardation in some European fishes infected with *E. seiboldi*. It seemed that *P. subviridis* infected with E. rostralis of the present study were anemic, and this effect was increased when the intensity of infection was increased.

The reduction in values of Hb%, PCV and RBCs of the infected fishes in the present study was also noticed in fishes naturally or experimentally infected with some vibrios (Anderson & Conroy, 1970; Harbell et al., 1979), with other bacterial agents (Iwama et al., 1986), with naturally infection with protozoan parasites (Smirnova, 1970; Joshi, 1982; Hoffmann & Lommel, 1984) or with helminth parasites (Radhriskrishnan et al., 1983) or with crustacean parasites (Ananda Raja et al., 2020; Ananda Raja et al., 2023).

In general, results of Table (1) show that all blood parameters of male fishes were higher than those of females. The same results were obtained by Ezzat et al. (1973), Al-Mehdi & Khan (1984) and Al-Hassan et al. (1990). Such differences between sexes led Fourie & Hattingh (1976) to suggest that these haematological parameters may be attributed to sex differences. According to Raizada et al. (1983), such differences are related to differences in the metabolic rates, which are higher in males than in females.

The high statistical correlations between values of Hb% and PCV among different groups and both sexes (Table 2) come in agreement with Al-Abood (1992) who found the same correlation between these two parameters in the catfish Silurus triostegus. Al-Mehdi & Khan (1984) suggested that PCV can be used as a general index of haematological states.

WBCs increased in lightly and mildly infected fishes, respectively (Table 1), but their conspicuous fall occurred in heavily infected fishes. Similar observation was noticed by Joshi (1982) who noted a lower WBCs in heavily infected catfish *Clarias batrachus* with some trypanosomes. The increase of WBCs in infected fishes was also observed by Yamashita (1967) in ulcerative disease of rockfish *Sebasticus marmoratus* and in trypanosome infection of *C. batrachus* (Joshi, 1982). According to the later researcher, such results can be explained on the basis that a gradual immunization occurs in infected fishes with prolongation of period of infection and with increment of parasite intensity.

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Conflict of interests

The authors have no conflict of interest to declare.

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