

RESEARCH ARTICLE

Investigations on endohelminth fauna of teleost fishes of Aras and Murat Rivers in Turkey

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ABSTRACT

In this study which has been done between April 2008 and June 2009, fishes captured from Ağrı and Erzurum were examined by endoparasite fauna. Examined fishes are as follows: *Acanthobrama marmid* Heckel, 1843, *Alburnus akili* Battalgil, 1942, *Barbus plebejus* Bonaparte, 1839, *Barbus mursa* Güldenstädt, 1773, *Capoeta barroisi* Lortet in Barrois, 1894, *Capoeta capoeta* Güldenstädt, 1773, *Cyprinus carpio* Linnaeus, 1758, *Leuciscus cephalus* Linnaeus, 1758. Consequently, a total of 908 individual parasites were detected from six parasite species; *Rhabdochona denudata* Dujardin, 1845 (Nematoda), *Neoechinorhynchus* sp. and *Pomphorhynchus* sp. (Acanthocephala), *Bothriocephalus acheilognathi* Yamaguti, 1934, and *Caryophyllaeus laticeps* Pallas, 1781 (Cestoda), *Allocreadium isoporum* Looss, 1894 (Digenea). The distribution of the infection prevalence, mean intensity, and abundance values of parasite species were determined. As a result of our study, 93 of 233 (39.91%) fish were reported with parasites.

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Introduction

Fishes are one of the important basic nutritional elements in animal food sources and provide high-quality protein and a large variety of vitamins and minerals (Öztürk, 2005; Balami et al., 2019). Fishes are constantly together with parasites in the natural environment, parasitic diseases constitute one of the most important problems of fisheries (Taşçi & Topçu, 1990;

Öztürk, 2005; Aydoğdu & Selver, 2006). Parasites exogenously live in the gills, skin, fins, and eyes, endogenously live in various internal organs of fish species (Dörtbudak et al., 2019). It is reported that almost 50% of the fish larvae die from parasitic infections in crowded pools (Dörücü & Mutlu, 2008). Parasites are reducing the nutritional value of the fish and also prevent them from growing, reproducing, and feeding (Özan & Kır, 2005).

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Helminth parasites can cause disease in the tissues and organs of the fish (Aydoğdu & Selver, 2006). During their development, helminths cause effects such as poor appetite, discoloration, swimming disorder, blindness, weakness, hemorrhage in tissues, and gill and skin deformities. Especially inflammation and degeneration in the intestines lead to fish deaths (Dörtbudak et al., 2019; Aktürk et al., 2020). The subject of fish diseases increasing aquaculture sector in Turkey has gained great importance day by day. So, it is necessary to know the parasite fauna of fish in inland waters (Karatoy & Soylu, 2006).

This study aimed to investigate the endohelminth fauna of teleost fishes of Aras and Murat Rivers in Turkey.

Material and Methods

This study was carried out between April 2008 and June 2009. Fish samples were caught using fishing nets and fishing rods from between Pasinler and Köprüköy in Erzurum (39°57' N-41° 51' E) and from Tutak (39° 29' N-42° 40' E), Hamur (39° 36' N-42° 57' E), and Taşlıçay (39° 35' N-43° 35' E) regions of the Ağrı as shown in Figure 1.

A total of 233 fish specimens were evaluated as part of this study, of which 98 were from the Murat River (Ağrı) and 135 were from the Aras River (Erzurum). The fish specimens are, *Acanthobrama marmid* Heckel, 1843, *Alburnus akili* Battalgil, 1942, *Barbus mursa* GÜldenstädt, 1773, *Barbus plebejus* Bonaparte, 1839, *Capoeta barroisi* Lortet in Barrois, 1894, *Capoeta capoeta* GÜldenstädt, 1773, *Cyprinus carpio* Linnaeus, 1758, *Leuciscus cephalus* Linnaeus, 1758 species.

The fish specimens were transported as alive within aquariums to the Atatürk University Parasitology Laboratory of the Biology Department of Faculty of Science. The method follows by Kuru (1975), Balık & Ustaoglu (1992), Geldiay & Balık (1996) were used to identification of the fish species. In this study, the body cavities, livers, stomachs, and intestines of fishes were examined in terms of helminth fauna. Only helminths were found in the body cavity, stomach, and intestines. After the examinations were completed with aid of a binocular stereomicroscope (Olympus BH-2, Japan), the nematodes were taken into plastic tubes containing 70% alcohol. These tubes were labelled with the date, the fish species, parasite type, and count, and were stored. Preparations out of these were made by covering them with glycerin jelly. Other parasites were taken between the glasses and cover slides and were fixed using A.F.A solution. These were stained as suggested by Pritchard & Kruse (1982).

Identification of the parasites was performed using the guidelines specified by the researcher (Markevich, 1951;

Bykhovskaya-Pavlovskaya, 1962; Yamaguti, 1963a-c). The prevalence, mean intensity and mean abundance percentage values were calculated as suggested by Bush et al. (1997).

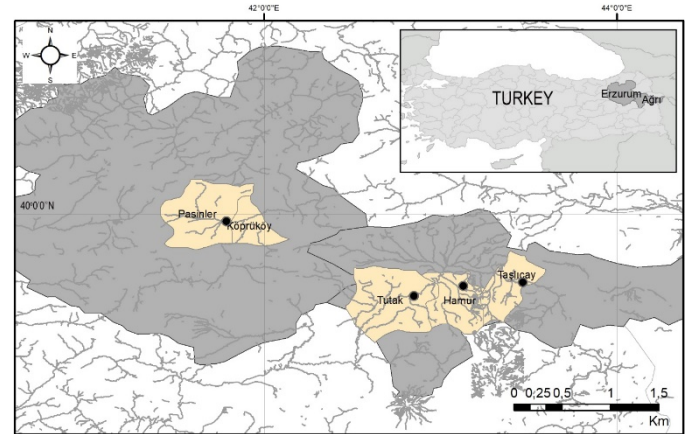


Figure 1. Map showing the Aras and Murat Rivers with black circles where the fish caught

Results

A total of 233 fish were caught as part of this study, 98 of which were from the Murat River and 135 from the Aras River. These 233 fish consist of 17 *Acanthobrama marmid*, 11 *Alburnus akili*, 4 *Barbus mursa*, 22 *Barbus plebejus*, 156 *Capoeta capoeta*, 15 *Capoeta barroisi*, 3 *Cyprinus carpio*, and 5 *Leuciscus cephalus* of which 93 (39.91%) were found to be infected with parasites. The inspections have revealed two species of Cestoda (*Bothriocephalus acheilognathi*, *Caryophyllaeus laticeps*), two species of Acanthocephala (*Neoechinorhynchus* sp., *Pomphorhynchus* sp.), one species of Nematoda (*Rhabdochona denudata*), and one species of Digena (*Allocreadium isoporum*) to be present amongst the fish helminths (Figure 2). Of those, *Bothriocephalus acheilognathi* was found in *Cyprinus carpio* caught from the Aras River, *Caryophyllaeus laticeps* was found in *Acanthobrama marmid* and in *C. capoeta* caught from the Aras River, *Pomphorhynchus* sp. was found in the *Leuciscus cephalus*, *C. capoeta* and *Barbus plebejus* caught from the Aras River, while no *Pomphorhynchus* sp. was determined in fish caught from the Murat River. *Allocreadium isoporum*, on the other hand, was determined only in *Barbus plebejus* caught from the Murat River. *Neoechinorhynchus* sp. was determined in *Capoeta capoeta* and *Barbus plebejus* caught from the Aras River and in *Capoeta barroisi* caught from the Murat River. *Rhabdochona denudata* was present in *Capoeta capoeta* and *Barbus plebejus* of both Murat and Aras River fish, in addition to the *Barbus mursa* of the Aras River. No parasites were determined in *Leuciscus cephalus* and *Alburnus akili* fish caught from the Murat River (Table 1).

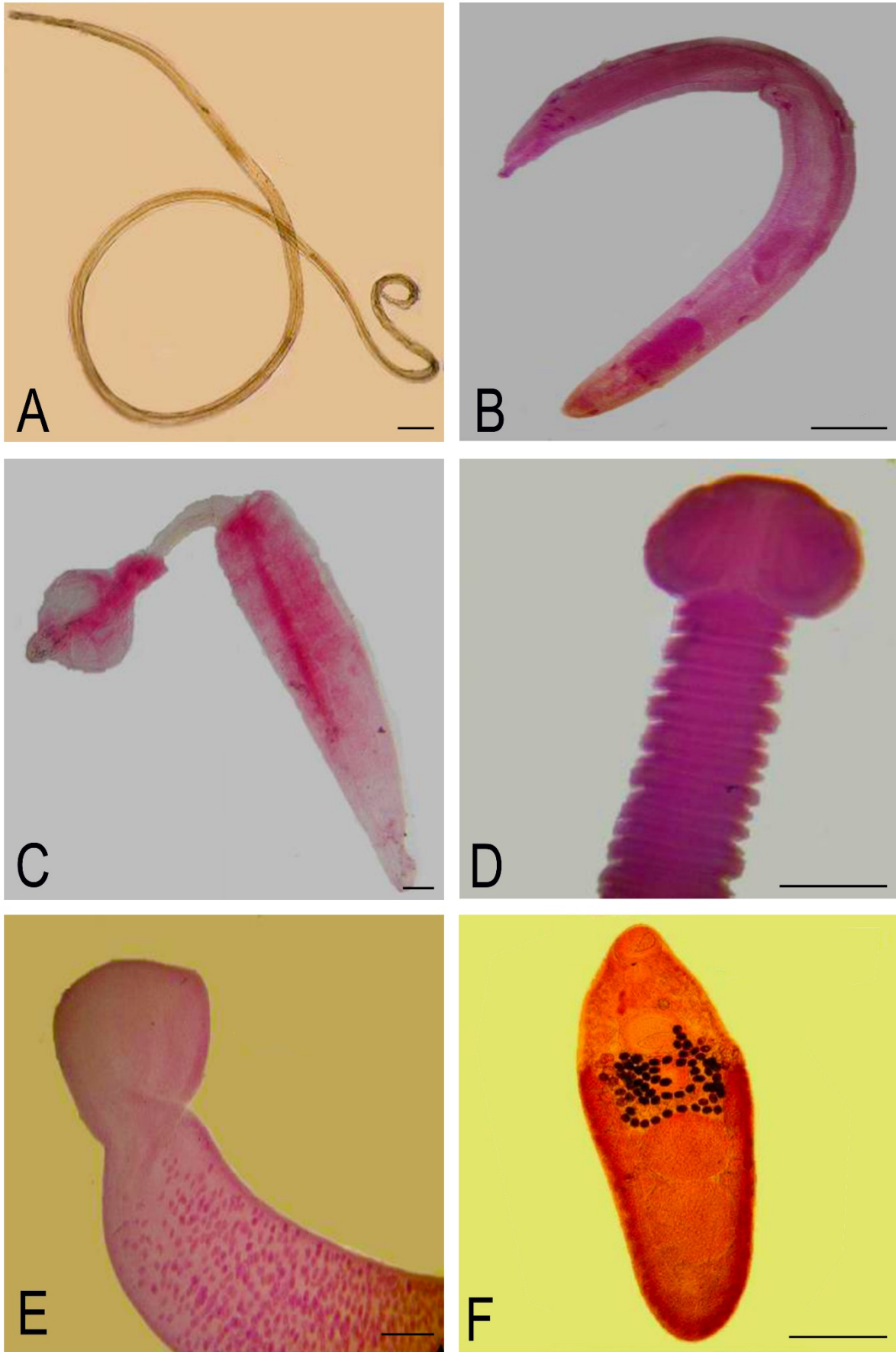


Figure 2. Some types of helminths A) *Rhabdochona denudata* (Dujardin, 1845) Railliet, 1916 (♂), B) *Neoechinorhynchus* sp. Stiles and Hassall, 1905 (♂), C) *Pomporhynchus* sp. Monticelli, 1905 (♀), D) *Bothriocephalus acheilognathi* Yamaguti, 1934 scolex parts, E) *Caryophyllaeus laticeps* (Pallas, 1781) Lühe, 1910 anterior part, F) *Allocreadium isoporum* (Looss, 1894) Looss, 1902, Scale bars: 0.5 mm.

Discussion

Parasitic nematodes are very commonly found in fish. While there are numerous studies performed on nematodes in Turkey (Türkmen & Tüzer, 1992; Aydoğdu & Altunel, 2002; Öztürk et al., 2002; Kır & Özkan, 2005; Özkan & Kır, 2005), studies involving *Rhabdochona denudata* which we were able to identify as part of the present study are quite limited studied in Turkey. The presence of *Rhabdochona* species in freshwater fishes in Turkey was first determined in Balıklı Kaplıca and Topardıç streams (Sivas), in *C. macrostomus* and *G. rufa* (Saygi & Bardakçı, 1990).

In the present study, only one nematode species *Rhabdochona denudata* was determined. The prevalence of *R. denudata* in *C. capoeta* fish caught from the Aras River was determined as 12%, while mean intensity was determined as 2.82 and mean abundance was determined as 0.33. In the *C. capoeta* fish caught from the Murat River, its prevalence was 5%, the mean intensity was 2.33, and the mean abundance was 0.11. For the *B. plebejus* caught from the Aras River, its prevalence was determined as 15.4%, while its mean intensity was 1.5 and its mean abundance was 0.23, but for the same species of fish caught from the Murat River, these values are 11%, 1, and 0.11, respectively. The highest prevalence for *R. denudata* is determined in the *B. mursa* fish caught from the Aras River with 25%.

In studies conducted in Turkey related to Acanthocephalan, it is reported that *Neoechinorhynchus* is quite common. In a study performed in the İznik Lake, seven out of 145 common carps (*Cyprinus carpio*) were found to have *Neoechinorhynchus rutilus* (Aydoğdu et al., 1997). The same parasite was reported to be present in (with a total count of 14) in 37 *Capoeta trutta* fish caught from the Kocakale region of the Keban Dam Lake of the Elazığ province into which the city sewers are being discharged (Sağlam & Sarıyüpoğlu, 2002). It is reported that 165 out of the 423 (39.01%) sailton pupfish (*Aphanius chantrei*) caught from the Sarıkum Lagoon (Sinop province) were infected with *Neoechinorhynchus rutilus* (Öztürk, 2005).

Another acanthocephalan species, *Pomphorhynchus laevis*, was reported in a total of seven fish distributed amongst the *Leuciscus cephalus*, *Carassius carassius*, *Carassius auratus*, *Nemacheilus* sp., and *Alburnus alburnus* species caught from the Enne Dam Lake (Kütahya) (Koyun, 2001). Buhurcu (2006) reports that 21 *Alburnus nasreddini* out of 34 (61.8%) caught from the Akşehir Lake were infected with *Pomphorhynchus laevis*.

In the present study, the prevalence of *Neoechinorhynchus* sp. in *Capoeta capoeta* fish caught from the Aras River was determined as 58%, while the median intensity was 2.2 and the median abundance was 1.3. No acanthocephalan species were encountered in *Capoeta capoeta* fish caught from the Murat River, however. While the *Barbus plebejus* fish caught from the Aras River were found to have a *Neoechinorhynchus* sp. prevalence of 23.1%, the median intensity of 5, and median abundance of 1.1, no *Neoechinorhynchus* sp. was encountered in *Barbus plebejus* from the Murat River. That being said, all (100%) of the *Capoeta barroisi* fish caught from the Murat River were found to be infected with *Neoechinorhynchus* sp., for which the median intensity and median abundance was determined as 43.80. The parasite was not encountered in any other fish species caught from either of the Aras and Murat Rivers. In the present study, *Pomphorhynchus* sp. prevalence for the Aras River alone was determined as 6% for *Capoeta capoeta*, 15.4% for *Barbus plebejus*, and 50% for *Leuciscus cephalus*.

In the studies performed related to *Bothriocephalus acheilognathi* in Turkey; 4 out of 72 (5%) common carps (*Cyprinus carpio*) caught from the İznik Lake were found to be infected with *Bothriocephalus acheilognathi*, and in 13 out of 72 (18%) zander fish (*R. frisii*) (Türkmen & Tüzer, 1992). Oğuz et al. (1996) report that of the 46 common carps (*Cyprinus carpio*) caught from the Apolyont Lake, a total of 9 *Bothriocephalus* sp. were identified. The same parasite was encountered in 54 out of the 337 *Alburnus alburnus* caught from the Enne Dam Lake (Koyun, 2001). *Caryophyllaeus laticeps* is also commonly encountered in Turkey. A study has reported 25 out of 72 (35%) carps (*Cyprinus carpio*) in İznik Lake contained the parasite (Türkmen & Tüzer, 1992), while in Kovada Lake the rate of infection is 58 out of 147 common carps (*Cyprinus carpio*) (Becer & Kara, 1998). *C. laticeps* was also encountered in the carps living in the Dalyan Lagoon (Karacabey) (Aydogdu et al., 2001), while mirror carps of the Seyhan River were found to contain *Caryophyllaeus* sp. (Cengizler et al., 2001) and *C. laticeps* was determined in the freshwater trouts (*Abramis brama*) of the Terkos Lake (Karatoş & Soylu, 2006). Furthermore, Soylu (2006) reported the presence of *C. laticeps* (Cestoda) in the white seabream fish inspected in their study.

In the present study, the prevalence of *Bothriocephalus acheilognathi* in a single *C. carpio* of 11.5 cm length caught from the Aras River was recorded as 33%, with a mean intensity of 2 and mean abundance of 0.67. *Caryophyllaeus laticeps*, on the other hand, were found in two specimens of *Capoeta capoeta* amongst the 94 total caught from the Aras River with 2% prevalence, mean intensity of 1, and mean abundance of 0.02.

Table 1. Distribution of the identified parasites based on fish species

Fish species		Aras River					Murat River			
		<i>A.marmid</i>	<i>B.mursa</i>	<i>B.plebejus</i>	<i>C.capoeta</i>	<i>C.carpio</i>	<i>L.cephalus</i>	<i>C.barroisi</i>	<i>C.capoeta</i>	<i>B.plebejus</i>
Number of fish samples		17	4	13	94	3	4	15	62	9
Parasitic Fish Count	<i>A. isoporum</i>	0	0	0	0	0	0	0	0	1
	<i>B. acheilognathi</i>	0	0	0	0	1	0	0	0	0
	<i>C. laticeps</i>	1	0	0	2	0	0	0	0	0
	<i>Neoechinorhynchus</i> sp.	0	0	3	55	0	0	15	0	0
	<i>Pomphorhynchus</i> sp.	0	0	2	6	0	2	0	0	0
	<i>R. denudata</i>	0	1	2	11	0	0	0	3	1
Infection Rate (%)	<i>A. isoporum</i>	0	0	0	0	0	0	0	0	11.1
	<i>B. acheilognathi</i>	0	0	0	0	33.3	0	0	0	0
	<i>C. laticeps</i>	5.9	0	0	2.1	0	0	0	0	0
	<i>Neoechinorhynchus</i> sp.	0	0	23.1	58.5	0	0	100	0	0
	<i>Pomphorhynchus</i> sp.	0	0	15.4	6.4	0	50	0	0	0
	<i>R. denudata</i>	0	25	15.4	11.7	0	0	0	4.8	11.1
Total Parasite Count	<i>A. isoporum</i>	0	0	0	0	0	0	0	0	2
	<i>B. acheilognathi</i>	0	0	0	0	2	0	0	0	0
	<i>C. laticeps</i>	1	0	0	2	0	0	0	0	0
	<i>Neoechinorhynchus</i> sp.	0	0	15	123	0	0	657	0	0
	<i>Pomphorhynchus</i> sp.	0	0	7	14	0	3	0	0	0
	<i>R. denudata</i>	0	40	3	31	0	0	0	7	1

Only one out of the 17 *A. marmid* fish caught from the Aras River contained the parasite, resulting in 6% prevalence, mean intensity of 1, and mean abundance of 0.06.

Many researchers have performed studies on Digeneans. One such study reports that, amongst the 26 common rudds (*Scardinius erythrophthalmus*) obtained from the Apolyont Lake, seven were infected with *Asymphyrodora markewitschi* (Oğuz & Öztürk, 1993). Zander fish (*Stizostedion lucioperca*) of the Eğridir Lake were found to contain *Bucephalus polymorphus* (Yıldırım et al., 1996). According to a study performed on the *Barbus* fish of the Doğançı Dam Lake reports that a total of 35 *A. isoporum* were observed in the 47 fish included in the study (with a 19.1% prevalence) (Aydoğdu & Altunel, 2002).

In this study, only *Allocreadium isoporum* (Digenea) was found in 16 cm length one *B. plebejus* caught from the Murat River. The average prevalence of *A. isoporum* was found to be 11%.

Among the reasons for the differences observed in the study, the location where the fish are caught, pollution rate of water, host and intermediate host population, seasonal variations, and methods used can be included.

Conclusion

A large portion of the parasites determined as part of the study consists of *Neoechinorhynchus* sp. of Acanthocephala phylum. It is followed by the *Rhabdochona denudata* which is a nematode, and *Pomphorhynchus* sp., which is an acanthocephalan. While *Bothriocephalus acheilognathi*, *Caryophyllaeus laticeps*, and *Allocreadium isoporum* were also identified, there were in small numbers. This study was an attempt to determine the endohelminth species in the fish fauna of Aras and Murat Rivers, and the prevalence, intensity, and abundance values of encountered parasite species were evaluated. We believe that our findings will provide useful information for future studies.

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“Endohelminths Encountered in Certain Cyprinides of Murat and Aras Rivers”, and in the 17th National Parasitology Congress-the Caucasus and the Middle East Parasitic Diseases Symposium held in Kars between 04-10 September 2011 with the title “The Relationships of Endohelminths Encountered in Cyprinids Caught from Aras River with the Fish Length”.

Compliance with Ethical Standards

Authors' Contributions

BAÇ and MCO designed the research plan and organized the study. BAÇ performed the fieldwork, collected the samples, carried out the laboratory work, analyzed the data, and wrote the manuscript. MCO read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

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