Original article

Nematode infestation in Red Mullet (Mullus surmuletus, Linnaeus, 1758) From Benghazi Coast, Libya

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ABSTRACT

Aims. This study was aimed to identify nematode parasites infecting M. surmuletus from cost of Benghazi and study the relationship between the prevalence of nematode parasites and sex, body weight body length of M. surmuletus. **Methods**. One hundred twenty of M. surmuletus were collected randomly from Benghazi cost during the period April to July 2012. Each fish was opened up dorso-ventrally then the sex of examined fishes was determined. **Results**. The result revealed that one hundred and five (87.5%) of the examined *M. surmuletus* were found infected with one or more nematode parasites, they are *Anisakis* spp. Larva, *Contracaecum* spp. Larva, *Echinorhynchus gadii* and *Philometra lateolabracis*. The highest infection rate was detected in *Anisakis* spp. Larva (75.2%) followed by *Contracaecum* spp. Larva (68.6%), *E. gadii* (48.5%) and *Philometra lateolabracis* (11.4%). All nematode parasites were found in the digestive tract of *M. surmuletus* except *Philometra lateolabracis* found in gonads of infected fish. Conclusion. The incidence of parasitic nematodes was relatively high in the city of Benghazi. An appropriate medications and educational programs must be given among these populations, to prevent the spread of infection and disease.

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INTRODUCTION

Fish which form minor and major links in food web of the aquatic ecosystems, harbor a wide array and, at times, large numbers of parasites. Fishes are important to man as a good source of protein in man s diet and the main source of protein supply for humans. It can serve to solve the malnutrition and deficiency of proteins in different parts of the world. The economic importance of fish is represented by their role as a food resource. For many countries, fishes are important for humans either by providing protein or by acting as a vector for human disease pathogens that can infect fish or other animals [1]. The feeding habits and wide diet spectrum of fish put them into contact. With several potential intermediate hosts of parasites. This might increase the presence of endoparasites.

in these fishes [2]. The diet of the host species is the main factor affecting the parasite community structure. Especially for the trematodes, acanthocephalans and nematodes transmitted to their host through a predator-prey relationship [3]. Parasite species might accumulate along the food chain. [4]. Fish, in most cases, harbor several species of pathogenic parasites that may cause mortality in the host. Decreasing the productivity of fish and transmitting diseases to other piscivorous vertebrates including humans [5]. Helminthes in fish may harm their hosts in a variety of ways, for example causing mechanical injury such as irritation, atrophy of tissues and occlusion of the alimentary tract, blood vessels or other ducts, they introduce toxic metabolic by-products that can produce changes. Which are able to produce changes in the blood, enzymes, vitamins and or hormonal activity of the host, Decreasing the ability of fish to feed, Influencing the growth rate of fish. Inhibiting the immune system of fish and affecting fish population size. Many helminth parasites use fish either as their second intermediate host or as a paratenic (transport) host. These helminthes complete their life cycle when their fish intermediate or paratenic host is ingested by their definitive host, which can be another fish or some other vertebrate [6]. The most important reason for studying fish parasites is to studying the relationships between parasites and fish to understand. Some human health problems through consuming fishes. The current study was aimed at identifying nematode parasites infecting *M. surmuletus* from cost of Benghazi and study the relationship between the prevalence of nematode parasites and sex, body weight body length of *M. surmuletus*.

METHODS

Study area

Benghazi city (23°10 N /20°06 E) extend on Mediterranean coast, is the second largest city occupying an area of approximately 240 Km² and situated in north-east of Libya, It's population is about 674,951 has climate of moderate wet winters and worm, dry summers. During the winter the temperature may drop to less than 5C° at night whereas it rises up to 38C° at mid-day during the summer and high humidity.

Fish sampling

One hundred twenty of *M. surmuletus* were collected randomly with the help of fishermen with their permission from Benghazi cost during the period April to July 2012.

Examination of fish for nematodes

Fishes were collected by netting, then immediately transported to the laboratory of zoology department, Faculty of Science, Benghazi University, the body length was measured by means of meter. the body weight measured to the nearest gram using an electronic balance. Each fish was opened up dorso-ventrally then the sex of examined fishes was determined, and the internal organs liver, heart and body cavity.

Examination of nematode parasites

The elementary canal of each fish was removed and divided into three sections (stomach, anterior and posterior intestine and rectum) then placed in a separate petri dish contain isotonic saline solution (9% NaCl). Each organ is opened by a fine scissor in saline. All nematode parasites found were collected and washed again in isotonic saline solution for several times.

Statistical analysis

Statistical analysis was carried out to determine the prevalence and significance of the date. The logistic regression [7] used to find out the relationships between parasitic infection and sex, the body length and body weight. Prevalence was calculated as the percentage of infected fish and the number of nematodes per infected fish. Chi-square was employed to find out the significance of the relationship between body length, weight and sex. The accepted level of significance was $p<0.005$ was considered significance during the using the test. All analysis was computed in windows environment of statistical of program (SPSS).

RESULTS

Prevalence

One hundred and five (87.5%) were found to be infected with nematode parasites. There was a significant difference between infected and non-infected fishes ($p=0.000$) (Table1).

Table 1. Overall prevalence of nematodes parasites in examined M. surmuletus

No. examined	Infected(%)	Non – infected(%)
120	105 (87.5%)	15 (12.5%)

The results revealed that four species of nematode parasites were detected. Three nematodes (*Anisakis* spp. Larva, *Contracaecum* spp. Larva and *Philometra lateolabracis*), and one species of *Acanthocephalla* (*Echinorhynchus gadii*). The result showed that, the most common nematode parasite with highest infection rate was *Anisakis* spp. Larva 75.2%(79/105) followed by *Contracaecum* spp. Larva 68.6% (71/105), *E. gadii* 48.5% (51/105) and *P. lateolabracis* 11.4% (12/105) (Table 2). All detected parasites were found attached at various areas of the gastrointestinal tract, except *P. lateolabracis* found in gonads (Table 2).

Table 2. Prevalence of nematode species in infected M. surmuletus

Type of nematodes	No. infected (%)
Anisakis spp. Larva	**79 (75.2%)**
Contracaecum spp. Larva	**71 (68.6%)**
Philometra lateolabracis	**12 (11.4%)**
Echinorhynchus gadii	**51 (48.5%)**

Prevalence and sex

Out of a total of 120 examined M. surmuletus, 51 were males and 69 were females. Both males and females were infected with nematode parasites, the result showed that prevalence of infection was higher in males 47 (92.2%) than females 58 (84.1%). No significant difference was detected between prevalence and sex (P=0.185).

Table 3. Relationship between infection of nematode parasites of examined fish and sex.

Sex	No. examined	Non- infected	No. infected
Males	51	4 (7.8%)	47 (92.2%)
Females	69	11 (15.9%)	58 (84.1%)
Total	120	15(12.5%)	105 (87.5%)

Prevalence and age

Should be "The prevalence of parasitic nematode infection varied in fish of different age groups, varying in prevalence from 20% in fish older than 1 year, to 80% in fish younger than 1 year. The results showed that there were significant differences between infection and age groups (P = 0.00) (Table 4).

Table 4. Relationship between infection of nematode parasites of examined fish and age.

Age (year)	Out of total examined	Out of infected
<1 year	94 (78.3%)	84 (80%)
>1 year	26 (21.6%)	21 (20%)
Total	120	105

Prevalence and body length

The prevalence of the nematodes varied in different length classes of *M. surmuletus*, higher prevalence rate was observed in fish measured less than 15cm (55.2%) followed by those measured 15-20 cm (40.9%) and those more than 20cm (3.8%) (Table 5). No significant difference between prevalence and body length (P =.278).

Table 5. Relationship between infection of nematode parasites of infected fish and body length of infected fish

Body length (cm)	Infected (%)
less than 15	58 (55.2%)
15-20	43 (40.9%)
more than 20	4 (3.8%)

Prevalence and body weight

The prevalence of the nematodes varied according to the different body weights of M. surmuletus. The higher prevalence was observed in fish with body weights between 41-80gm (70.4%), followed by those with body weight less than 40gm (19.04%) and those fish with body weight more than 80gm (10.4%). The results revealed that there was a significant difference between the prevalence and body weight of infected fish (P= 0.015) (Table 6).

Table 6. Relationship between infection of nematode parasites and body weight (gm) of infected fish

Body Weight (gm)	Infected (%)
less than 40	20 (19.04%)
41-80	74 (70.4%)
more than 80	11 (10.4%)

Prevalence and type of infection

Thirty-five (33.3%) of infected *M. surmuletus* had single infection and seventy (66.7 %) had mixed infection (Table 7). The highest single infection of nematode parasites of *M. surmuletus* was detected in *Contracaecum spp*. Larva at incidence rate 46.4% followed by *Anisakis spp*. Larva 21.5%, *Philometra lateolabracis* 8.3% and the lowest was detected in *Echinorhynchus gadii* 7.8% (Table 8).

Table 7. Single and mixed infection of nematode parasites of infected fishes

Type infection	No. infected	%
Single infection	35	33.3
Mixed infection	70	66.7
Total	105	100.0

On the other hand, most mixed infection was observed between two species *Anisakis spp*. Larva+ *Contracaecum spp*. Larva (21.4%) while mixed infection with three specie was observed between *Anisakis spp*. Larva+ *Contracaecum spp*. Larva+ *Echinorhynchus gadii* at incidence rate (42.9%). The results showed that there was significant difference between single and mixed infection with nematode parasites (P = 0.001).

Table 8. Single and mixed infections of nematode parasites in infected M. surmuletus

Type of nematodes	No. infected	Type of infection	
		Single	Mixed
***Anisakis spp.* Larva**	79	17 (21.5%)	62 (78.4%)
***Contracaecum spp.* Larva**	71	33 (46.4%)	38 (53.5%)
Philometra lateolabracis	12	1 (8.3%)	11 (91.7%)
Echinorhynchus gadii	51	4 (7.8%)	47 (92.2%)

DISCUSSION

The study of *M. surmuletus* is of a great importance in fisheries, especially in terms of commercial and aquaculture, *M. surmuletus* widely distributed throughout the coastal seawater of Benghazi, Libya. In Libya, there are a few studies had been done of helminthes parasites of marine fish [8-12].

The present study revealed that the prevalence rate of nematode parasites was 87.5% in examined fishes. This prevalence was higher than those previously reported by other authors 41.27% [13], 33.33% [14], 67.6%, 31.5% [15] and 63.11% [16]. On other hand, the present prevalence was lower than prevalences reported by 97.7% [17], 100% [18]. Such variation in the obtained data could be due to fish health condition, affected by environmental, geographical distribution, water temperatures, type of water supply, crowding of fishes, transport, and management practices such as handling [19, 20].

The present study revealed that four species of nematode parasites were detected among *M. surmuletus*, they are *Anisakis spp*. Larva, *Contracaecum spp*. Larva, *E. gadi* and *P. lateolabracis*. The same helminthes parasite species were recorded from different fishes around the world [18,21-23]. The detected prevalence of *Anisakis spp*. Larva. in the present study was 75.2%. Such prevalence was higher than those reported by other previous studies 45% [24], 50% [25], 2.4% [26] and lower than incidence reported by Valero, López-Cuello [13] at 87.97%.

Anisakid larvae have been detected worldwide in a large variety of fish belonging approximately to 200 fish species [27]. A higher prevalence of anisakid infestation in different fish species depends on the availability of the final host in the region and the parasite's ability to complete its life cycle there [28].

In the present study *Contracaecum spp.* larva was detected at incidence rate 68.6%. This prevalence was higher than those reported in previous studies 22% [29], 42.6% [30]; 3.3% [18]; 25.9% [31]; 3% [32]. However, a lower than prevalence reported by Boomker [33] at 95.3%, Lymbery, Doupé [34] at 81-100% in species of *Mullet*, Valero, López-Cuello [13] at 87.97%.

The result revealed that of *P. lateolabracis* was detected at incidence 11.4%, this prevalence was higher than reported by Moravec and Justine [21] at 1.5%, and lower than prevalence was reported by Kardousha [35] at 20%, Moravec, Glamuzina [36] at 21% and Quiazon, Yoshinaga [37] at 89%.

The importance of *Philometra spp*. parasitizing marine fishes has increased due to the rapid development of marine aquaculture, because these pathogenic parasites may cause serious damage to infected fish or, when parasitic in gonads significantly decrease fish reproduction [38,39].

P. lateolabracis is a wide spread species. It was reported from different parts around the world [36, 40]. Prevalence of *E. gadi* obtained in the present study was 48.5%. Such incidence was higher than those reported by Sobecka, Jurkiewicz [41] at 46.3%. However, a lower than those reported by Sobecka, Szostakowska [23] at 62.5% and Pomeranian Bay at 96.2%.

The present study showed that both males and females *M. Surmuletus* were infected with nematode parasites at prevalence 92.2% and 48.1% respectively. The present finding agreed with Studies conducted on Nile fish in Egypt and some fishes River Oshun, Nigeria [17,42] and disagreed with Al-Zubaidy [31], Aliyu and Solomon [43] and Idris, Balarabe-Musa [44]. The variation in prevalence between sexes could be due differential feeding or as a result of different levels of resistance to infection. It could be also due to physiological state of the female [45].

The present study showed both age group of fish were infected, also showed that there is higher infection in age group <1 year (80%) than those fish at age group >1 year (20%). A significant difference was observed between prevalence and age of *M. surmuletus* ($P<0.05$), probably due to the longer time they were exposed to the environment [46] also reported that increase in number of parasites and its diversity increased with increase of fish age.

The prevalence of nematode parasites is not affected by the length of *M. surmuletus*, no significant difference was detected between body length and prevalence of nematode infection ($P = .278$). This finding agree with results reported by Barson [30] and Olurin, Okafor [42], and disagree with other previous results [16, 17, 44, 47].

The relationship between incidence of parasites infection and the body length of host may have varied according to the species of the hosts and the parasites [48].

The body weight of M. *surmuletus* had effect on the prevalence of helminthes parasites. In this study, the prevalence of nematode parasites increases with the increase in body weight of fishes and there were significant differences in discernible between the body weight and prevalence of nematode infection among the three classes of fishes. This finding in agreement with previous reported result [47] and disagree with other reported [42].

The prevalence increased with increasing the fish body weight may be due to the increase and growth of the internal organs of the hosts leading to the increase in the surface areas of infection as suggested by Khidr [49] and Hagras, El-Naggar [50] or could be due to the exposure time of infection [51].

The present study revealed that 33.3% and 66.7% of infection fishes were single and mixed infection respectively among M. *surmuletus*. Mixed infection has been reported among other helminthes parasites infection in different fish species around the world [16,43,47].

CONCLUSION

In conclusion, the incidence of parasitic nematodes was relatively high in the city of Benghazi. Several other studies should be conducted to find out if there are other hosts harboring these parasites. An appropriate medications and educational programs must be given among these populations, to prevent the spread of infection and disease.

Disclaimer
The article has not been previously presented or published, and is not part of a thesis project.

Conflict of Interest
There are no financial, personal, or professional conflicts of interest to declare.

REFERENCES

1. Bunkley-Williams L, Williams EH. Parasites of Puerto Rican freshwater sport fishes: Department of Natural and Environmental Resources San Juan, PR; 1994.
2. Alves DR, Luque JL. Community ecology of the metazoan parasites of white croaker, Micropogonias furnieri (Osteichthyes: Sciaenidae), from the coastal zone of the State of Rio de Janeiro, Brazil. Memórias do Instituto Oswaldo Cruz. 2001;96:145-53.
3. Sasal P, Niquil N, Bartoli P. Community structure of digenean parasites of sparid and labrid fishes of the Mediterranean Sea: a new approach. Parasitology. 1999;119(6):635-48.
4. Aho A. Community richness in parasites of some fieshwater fishes North America. Species diversity in ecological communites: Historical and geographical perspectives. 1993:185-93.
5. Williams A, Jones N. Didymozoid trematode infection of snapper. Pagrus auratus (Sparidea) off Western Australia: parasite population biology and fishery implications. 1976;16:113-29.
6. Poulin R, Valtonen E. Interspecific associations among larval helminths in fish. International Journal for Parasitology. 2001;31(14):1589-96.
7. Dowdy S, Wearden S, Chilko D. Statistics for Research, A John Wiley & Sons. Inc Publication 204e210. 2004.
8. El-Marimi MA. the Aschelminthes of the Flathead Mullet Mugilcephalus (Linnaeus , a758) in Ain Zayanah lagoon and costal of Benghazi, Libya. [Msc. Thesis]: University of Garyounis; 2002.
9. Al-Bassel D, Ouhida A. Trematode parasites of mullet from Misurata, Libya. Journal of Veterinary Medical Research. 2008;18(2):34-7.
10. AL-Bassel DA, AL-Swaehly AI, Abd EL-Baki AS, Atwa MT, M. A-SR. Parasites Of Mullets from two different water. . International congress Geotunis 2009. 2009.
11. Ahmed A. Studies on Helminth parasites of Marine Fishes: Mullus serpentullus, Epinepheles guaza and Pargrus pargrus (Linnaeus, 1958) in coastal seawater of Sirt, Libya: Msc. Thesis, Sirt university; 2010.
12. Kassem HH, Bowashi SM. Prevalence of Anisakid nematode larvae infecting some marine fishes from the Libyan Coast. Journal of the Egyptian Society of Parasitology. 2015;45(3):609-16.
13. Valero A, López-Cuello MM, Benítez R, Adroher F. Anisakis spp. in European hake, Merluccius merluccius (L.) from the Atlantic off north-west Africa and the Mediterranean off southern Spain. Acta Parasitologica. 2006;51(3):209-12.
14. Paradižnik V, Radujković B. Digenea trematodes in fish of the North Adriatic Sea. Acta Adriatica. 2007;48(2):115-29.
15. Al-Bassel DA, Hussein A-NA. A survey on parasites infecting mullets from Egypt and Libya. Egyptian Academic Journal of Biological Sciences, B Zoology. 2012;4(1):9-19.
16. Khanum H, Begum S, Begum A. Seasonal prevalence, intensity and organal distribution of helminth parasites in Macrognathus aculeatus. Dhaka University Journal of Biological Sciences. 2011;20(2):117-22.
17. Mansour M, Hassan S, Khidr AE-A, Ghanem M. General survey on certain helminth parasites infecting some Nile fishes at El-Mansoura, Egypt. Egyptian Journal of Aquatic Biology and Fisheries. 2003;7(4):423-46.
18. Felizardo NN, Knoff M, Pinto RM, Gomes DC. NEMÁTODOS ANISAKIDOS LARVARIOS DEL LENGUADO PARALICHTHYS ISOSCELES JORDAN, 1890 (PISCES: TELEOSTEI) EN BRASIL. Neotropical Helminthology. 2009;3(2).
19. Piazza RS, Martins ML, Guiraldelli L, Yamashita MM. Parasitic diseases of freshwater ornamental fishes commercialized in Florianópolis, Santa Catarina, Brazil. Boletim do Instituto de Pesca. 2006;32(1):51-7.
20. Kayis S, Ozcelep T, Capkin E, Altinok I. Protozoan and metazoan parasites of cultured fish in Turkey and their applied treatments. 2009.
21. Moravec F, Justine J-L. Two species of Philometra (Nematoda, Philometridae) from serranid fishes off New Caledonia. Acta Parasitologica. 2005;50(4):323-31.
22. Shamsi S, Aghazadeh-Meshgi M. Morphological and genetic characterisation of selected Contracaecum (Nematoda: Anisakidae) larvae in Iran. Iranian Journal of Fisheries Sciences. 2011;10(2):356-61.
23. Sobecka E, Szostakowska B, MacKenzie K, Hemmingsen W, Prajsnar S, Eydal M. Genetic and morphological variation in Echinorhynchus gadi Zoega in Müller, 1776 (Acanthocephala: Echinorhynchidae) from Atlantic cod Gadus morhua L. Journal of helminthology. 2012;86(1):16-25.

24. George-Nascimento M, Carvajal JG, Alcaíno H. Occurrence of Anisakis sp. larvae in the Chilean jack mackerel, Trachurus murphyi Nichols 1920. Revista Chilena de Historia Natural. 1983;56:31-7.
25. Marques J, Cabral H, Busi M, D'Amelio S. Molecular identification of Anisakis species from Pleuronectiformes off the Portuguese coast. Journal of Helminthology. 2006;80(1):47-51.
26. Quiazon K, Yoshinaga T, Santos M, Ogawa K. Identification of larval Anisakis spp. (Nematoda: Anisakidae) in Alaska pollock (Theragra chalcogramma) in northern Japan using morphological and molecular markers. Journal of Parasitology. 2009;95(5):1227-32
27. Chen Q, Zhang H, Song H, Yu H, Lin R, Zhu X. Prevalence of anisakid larvae in maricultured sea fish sold in Guangzhou, China. 2008.
28. Palm HW. Ecology of Pseudoterranova decipiens (Krabbe, 1878)(Nematoda: Anisakidae) from Antarctic waters. Parasitology Research. 1999;85:638-46.
29. Chishawa A. A survey of the parasites of three Siluriformes fish species in Lake Kariba. University of Zimbabwe Lake Kariba Research Station Bulletin. 1991;1(91):8-25.
30. Barson M. The occurrence of Contracaecum sp. larvae (Nematoda: Anisakidae) in the catfish Clarias gariepinus (Burchell) from Lake Chivero, Zimbabwe. Onderstepoort Journal of Veterinary Research. 2004;71(1):35-9.
31. Al-Zubaidy AB. Prevalence and Densities of Contracaecum sp. Larvae in Liza abu from Different Iraqi Water Bodies. Marine Scienes. 2009;20(1).
32. Adel M, Azizi HR, Nematolahi A. Scomberomorus commerson, a new paratenic host of Contracaecum sp. And Anisakis sp.(nematoda: Anisakidae) from Persian Gulf. World. 2013;5(3):310-4.
33. Boomker JDF. Parasites of South African freshwater fish. I. Some nematodes of the catfish [Clarias gariepinus (Burchell, 1822)] from the Hartbeespoort Dam. 1982.
34. Lymbery A, Doupé R, Munshi M, Wong T. Larvae of Contracaecum sp. among inshore fish species of southwestern Australia. Diseases of Aquatic Organisms. 2002;51(2):157-9.
35. Kardousha MM. The first record of Philometra lateolabracis Yamaguti, 1935 (Nematoda: Spirurida; Philometridae) from teleost fishes of the Arabian Gulf. 1999.
36. Moravec F, Glamuzina B, Marino G, Merella P, Di Cave D. Occurrence of Philometra lateolabracis (Nematoda: Philometridae) in the gonads of marine perciform fishes in the Mediterranean region. Diseases of Aquatic Organisms. 2003;53(3):267-9.
37. Quiazon KMA, Yoshinaga T, Ogawa K. Taxonomical study into two new species of Philometra (Nematoda: Philometridae) previously identified as Philometra lateolabracis (Yamaguti, 1935). Folia Parasitologica. 2008;55(1):29-41.
38. Sakaguchi S, Yamagata Y, Sako H. Reidentification of Philometra parasitic on the red sea bream [Pagrus major]. Bulletin of National Research Institute of Aquaculture (Japan). 1987.
39. Moravec F. Some aspects of the taxonomy and biology of dracunculoid nematodes parasitic in fishes: a review. Folia Parasitologica. 2004;51(1):1.
40. Merella P, Reñones O, Garippa G. Reinstatement of Philometra jordanoi (López-Neyra, 1951)(Nematoda: Philometridae): a parasite of the Mediterranean dusky grouper Epinephelus marginatus (Lowe)(Osteichthyes, Serranidae). Systematic Parasitology. 2005;61:203-6.
41. Sobecka E, Jurkiewicz E, Piasecki W. Parasite fauna of ide, Leuciscus idus (L.) in Lake Dąbie, Poland. Acta ichthyologica et Piscatoria. 2004;34(1):33-42.
42. Olurin K, Okafor J, Alade A, Asiru R, Ademiluwa J, Owonifari K, et al. Helminth Parasites of Sarotherodon galilaeus and Tilapia zillii (Pisces: Cichlidae) from River Oshun, Southwest Nigeria. Int J of Aquatic Science. 2012;3(2):49-55.
43. Aliyu M, Solomon J. The intestinal parasite of Clarias gariepinus found at lower Usman Dam, Abuja. Researcher. 2012;4(9):38-44.
44. Idris H, Balarabe-Musa B, Osawe S. The Incidence of endo-parasites of Clarias gariepinus (sharp tooth Catfish)(Burchell, 1822) and Oreochromis niloticus (Tilapia fish)(Linnaeus, 1758) in Jeremiah Usein river, Gwagwalada, Nigeria. 2013.
45. Emere M, Egbe N. Protozoan parasites of Synodontis clarias (A fresh water fish) in River Kaduna. Best Journal. 2006;3(3):58-64.
46. Oniye S, Aken'Ova T. The Dynamics of Adult and Larval Stages of Rhadinorhynchus (horridusLuhe, 1912) in Hyperopisus bebeoccidentalis (hunther) from Zaria Dam. Journal of Zoologic society of Nigeria. 1999;1:7-8.
47. Yakhchali M, Tehrani A-A, Ghoreishi M, editors. The occurrence of helminth parasites in the gastrointestinal of catfish (Silurus glanis Linnaeus 1758) from the Zarrine-roud river, Iran. Veterinary Research Forum; 2012: Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.
48. Leong T. Spatial distribution of Gill Monogeneans in a Tropical Cyprinid from Cenderuh Reservoir, Perak, Malaysia. MALAYAN NATURE JOURNAL. 1999;53:239-48.
49. Khidr A. Population dynamics of Enterogyrus cichlidarum (Monogenea: Ancyrocephalinae) from the stomach of Tilapia spp. in Egypt. International Journal for Parasitology. 1990;20(6):741-5.

50. Hagras A, El-Naggar M, Mansour M, El-Naggar A. Influence of age, length and sex of the catfish Clarias lazera on infestation with six monogenean parasites. Mans ScL Bull (Biol). 1995;22:37-55.
51. Muzzall PM, Sweet RD, Milewski CL. Occurrence of Diplostomum sp.(Trematoda: Diplostomatidae) in Pond-Reared Walleyes from Michigan. The Progressive Fish-Culturist. 1990;52(1):53-6.