Myxosporeans (Phylum Myxozoa) Parasitic on Some Fishes from Tigris River at North, Mid and South of Baghdad Province, Iraq

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Abstract. Between January and December 2009, a total of 154 fish samples were collected from Tigris River from three stations at north, mid and south of Baghdad province (Al-Taji, Al-Shawaka and Al-Zaafaraniya, respectively). These fishes belonged to ten species: *Alburnus caeruleus*, *Aspius vorax*, *Carasobarbus luteus*, *Carassius auratus*, *C. carassius*, *Cyprinus carpio*, *Cyprinion macrostomum*, *Liza abu*, *Mystus pelusius* and *Silurus triostegus.* The result of inspection showed that eight species of these fishes were infected with 20 species of parasites belonging to the class Myxosporea. These included one species each of *Unicauda* and *Chloromyxum*, two species of *Myxidium* and 16 species of *Myxobolus*. Among these parasites, *Myxobolus pfeifferi* infected the highest number of hosts (eight hosts), while six parasite species infected one host each. Among these fishes, *C. luteus* was infected with the highest number of parasite species (16 species), followed by *L. abu* (15 species) while no infection was detected from both *A. caeruleus* and *A. vorax*. In addition, a total of 27 new host records in Iraq were reported for 15 species of these parasites.

Key words: Myxosporea, *Unicauda*, *Chloromyxum*, *Myxidium*, *Myxobolus*, freshwater fishes, Tigris River, Iraq

Introduction

All living creatures including fishes are exposed to parasitic infections. This is a common case and it is not pollution avoidance, if the fishes are living in a good environment (37), but fishes come in danger when they are exposed to stress due to environmental disturbance and this disturbance might result in huge losses and death of fishes (20).

All myxozoans are among the major parasitic groups that affect fish life. They are very common in freshwater and marine fishes and can infect every organ (39; 14; 23; 40; 32). They cause production loos and death of fishes. Some fishes have to be discarded because they are unsightly and are not considered to be fit for human consumption (30). Myxozoans include 2180 myxosporean species (30). Members of the class Myxosporea, formerly known as class Sporozoa of phylum Protozoa, include important fish pathogens such as members of the genera *Myxobolus*, *Henneguya*, *Thelohanellus*, *Sphaeromyxa*, *Ceratomyxa*, *Chloromyxum*, *Myxidium*, *Zschokkella* and *Sphaerospora* (28; 44). Myxosporidean life cycles are very complex, which included alternation of generations or stages of growth and reproduction (43; 31).

Herzog (26) recorded the first occurrence of three myxosporeans from fishes of Iraq. Later on, researches up to date revealed the presence of 44 species (33). Some of such parasites, such as *Myxobolus pfeifferi* infecting *Liza abu* caused different degrees of petrifaction and degeneration in fish ovaries (34). The present work is undertaken to investigate myxosporean infections among ten species of fishes from three different sampling stations along Tigris River at Baghdad province.

Materials and Methods

Fishes were sampled from three stations in Tigris River at Baghdad province: Al-Taji, Al-Shawaka and Al-Zaafaraniya, during the period from January to December 2009. These fishes were captured by gill and cast nets of different mesh sizes. Fishes were brought to the laboratory with containers filled with ice. These fishes (Table 1) were identified according to Coad (22) and their scientific names followed Froese and Pauly (25). Total length and weight were recorded for each fish. Smears from the skin, gills and buccal cavity were examined under a compound microscope. Upon fish dissection, muscles and all internal organs were examined according to Amlacher (14). Parasite identification was done according to Bykhovskaya-Pavlovskaya *et al.* (21), Shul'man (43) and Hoffman (27). The index-catalogue of parasites and disease agents of fishes of Iraq (33) was followed to indicate number of previous host records for each parasite in order to minimize list of references of each parasite species.

Results and Discussion

The parasitological investigation revealed the occurrence of 20 species of myxosporeans on external and internal sites of the infected fishes. These parasites belong to the phylum Myxozoa, class Myxosporea, order Bivalvulida. This order includes one species of the family Chloromyxidae which is *Chloromyxum wardi*, two species of *Myxidium* of the family Myxidiidae and 17 species of the family Myxobolidae which included 16 species of *Myxobolus* and one species of *Unicauda* (Table 2). Data on fish sampling area, site of infection and percentage incidence of infection for each parasite species are shown in Table (2). The following is a brief account on the occurrence of these parasites.

Chloromyxum wardi Kudo, 1919: This parasite was recorded from *C. luteus*. The first report on this parasite in Iraq was from *L. abu* from Al-Madaen drainage network, south of Baghdad (35) and no more accounts were published on its occurrence in Iraq (33). So, *C. luteus* of the present study represents a new host record for this parasite in Iraq.

Myxidium pfeifferi Auerbach, 1908: This parasite was recorded from *C. luteus* and *L. abu*. Its first report from Iraq was from *Barbus sharpeyi* (= *Mesopotamichthys sharpeyi*) from Al-Qadisiya Dam Lake, northwest of Baghdad (16). Later on, it was reported from two other hosts which included *C. luteus* (reported as *B. luteus*) from Al-Madaen drainage network, south of Baghdad (35). So, *L. abu* of the present study represents a new host record for this parasite in Iraq.

Myxidium rhodei Léger, 1905: This parasite was recorded from *C. carpio*. The first report on this parasite in Iraq was from *Barbus sharpeyi* from Al-Qadisiya Dam Lake, northwest of Baghdad (16). It has been subsequently reported from nine other fish species (33) which included *C. carpi*o from Al-Zaafaraniya fish farm (41).

Myxobolus bramae Reuss, 1906: This parasite was recorded from *C. luteus* and *L. abu*. Its first report from Iraq was from *B. xanthopterus* (= *Luciobarbus xanthopterus*) from Al-Qadisiya Dam Lake, northwest of Baghdad (15). Later on, it was reported from two other hosts (33) which included *C. luteus* (reported as *B. luteus*) from the northern sector of the main drainage at Al-Mahmoodia city (17). So, *L. abu* of the present study represents a new host record for this parasite in Iraq.

Myxobolus cyprinicola Reuss, 1906: This parasite was recorded from *C. carpio*, *C. luteus*, *C. macrostomum* and *L. abu*. This parasite was recorded for the first time in Iraq from *C. carpio* from Dokan Lake (3). Later on, it was reported only from *B. grypus* and *Varicorhinus trutta* (synonym of *Capoeta trutta*) from a man-made lake at Al-Amiriya, northwest Baghdad city (9). So, *C. luteus*, *C. macrostomum* and *L. abu* of the present study represent three new host records for this parasite in Iraq (33).

Myxobolus dispar Thélohan, 1895: This parasite was recorded from *C. carassius*, *C. luteus* and *L. abu*. Its first report from Iraq was from *C. regium* from Tigris River at Salah Al-Dien province (1). Later on, it was reported from 11 hosts (33) which included *C. carassius* from Al-Zaafaraniya fish farm (36), *C. luteus* (reported as *B. luteus*) from a man-made lake at Al-Amiriya (9) and *L. abu* from Al-Qadisiya Dam Lake (15).

Myxobolus dogieli Bykhovskaya-Pavlovskaya and Bychowski, 1940: This parasite was recorded from *C. carassius*, *C. luteus* and *L. abu*. Its first record in Iraq was from *L. abu* from Tigris River at Salah Al-Dien province (1). Later on, it was reported from seven other hosts which included *C. luteus* (reported as *B. luteus*) from Hemrin Dam Lake (18). So, *C. carassius* of the present study represents a new host record for this parasite in Iraq (33).

Myxobolus drjagini (Achmerov, 1954): This parasite was recorded from *C. carassius*, *C. luteus*, *C. macrostomum* and *L. abu*. Its first report from Iraq was from *C. luteus* (reported as *B. luteus*) from the northern sector of the main drainage at Al-Mahmoodia city (17). So, *C. carassius*, *C. macrostomum* and *L. abu* of the present study represent three new host records for this parasite in Iraq (33).

Myxobolus koi Kudo, 1919: This parasite was recorded from *C. luteus*. Its first report from Iraq was from *S. glanis* from Tigris River at Mosul city (12). Later on, it was reported from four other hosts (33) which included *C. luteus* (reported as *B. luteus*) from a man-made lake at Al-Amiriya (9).

Myxobolus macrocapsularis Reuss, 1906: This parasite was recorded from *C. luteus* and *L. abu*. Its first report from Iraq was from *B. barbulus* from Dokan Lake

(3). The other report was from *C. luteus* (reported as *B. luteus*) from Tigris River at Tikreet city (10). So, *L. abu* of the present study represents a new host record for this parasite in Iraq (33).

Myxobolus mesopotamiae Molnár, Masoumian & Abbasi, 1996: This parasite was recorded from *L. abu*. Its first report from Iraq was from *C. luteus* (reported as *B. luteus*) from the Lesser Zab and Greater Zab rivers north of Iraq (4). The other host record for this parasite in Iraq was from *S. triostegus* from Al-Hammar marshes, Basrah (29). So, *L. abu* of the present study represents a new host record for this parasite in Iraq (33).

Myxobolus mülleri Bütschli, 1882: This parasite was recorded from *C. carassius* and *L. abu*. Its first report from Iraq was from *B. xanthopterus* (= *Luciobarbus xanthopterus*) (26). Later on, five other hosts were reported for this parasite in Iraq (33) which included *L. abu* from a man-made lake at Al-Amiriya (9). So, *C. carassius* of the present study represents a new host record for this parasite in Iraq (33).

Myxobolus musculi Keysselitz, 1908: This parasite was recorded from *C. luteus*, *C. carpio*, *L. abu* and *S. triostegus*. Its first report from Iraq was from *C. regium* and *C. macrostomum* from Tigris River at Tikreet city (11). No more hosts were reported later for this parasite in Iraq (33). So, *C. luteus*, *C. carpio*, *L. abu* and *S. triostegus* of the present study represent four new host records for this parasite in Iraq.

Myxobolus nemachili Weiser, 1949: This parasite was recorded from *C. luteus*. Its first report from Iraq was from *L. abu* from Tigris River at Salah Al-Dien province (1). Later on, it was reported from seven other hosts in Iraq (33) which included *C. luteus* (reported as *B. luteus*) from Al-Madaen drainage network, south of Baghdad (35).

Myxobolus oviformis Thélohan, 1882: This parasite was recorded from *C. carassius*, *C. luteus*, *C. carpio*, *L. abu* and *S. triostegus*. Its first report from Iraq was from *A. vorax*, *B. esocinus* (= *Luciobarbus esocinus*), *B. grypus* and *B. sharpeyi* (= *M. sharpeyi*) from different inland waters of Iraq (26). Later on, it was reported from 16 host species in Iraq (33) which included *C. carassius* from Al-Madaen drainage network, (35), *C. luteus* (reported as *B. luteus*) from Al-Qadisiya Dam Lake (15), *C. carpio* from Babylon fish farm (13) and *L. abu* from Tigris River at Al-Zaafaraniya (19). So, *S. triostegus* of the present study represents a new host record for this parasite in Iraq (33).

Myxobolus parvus Shul'man, 1962: This parasite was recorded from *C. luteus*, *C. carpio*, *L. abu* and *S. triostegus*. Its first report from Iraq was from *C. carpio* from Dokan Dam Lake, north Iraq (3). Later on, it was reported only from *B. xanthopterus* (= *L. xanthopterus*) from Tigris River at Tikreet city (10). So, *C. luteus*, *L. abu* and *S. triostegus* of the present study represent three new host records for this parasite in Iraq (33).

Myxobolus pfeifferi Thélohan, 1895: This parasite was recorded from *C. auratus*, *C. carassius*, *C. luteus*, *C. macrostomum*, *C. carpio*, *L. abu*, *M. pelusius* and *S. triostegus*. Its first report from Iraq was from *Acanthobrama marmid* from Tigris River at Neinava province (24). Later on, it was reported from 33 fish species in Iraq (33) which included *C. carassius* from Garmat Ali River, Basrah (5), *C. luteus* from Al-Hammar marsh (6), *C. macrostomum* from Tigris River at Baghdad (8), *C. carpio* from Diyala River (7), *L. abu* from Diyala River (7), *M. pelusius* from the northern sector of the main drainage at Al-Mahmoodia city (17) and *S. triostegus* (reported as *Parasilurus triostegus*) from Al-Hammar marsh (6). So, *C. auratus* of the present study represents a new host record for this parasite in Iraq (33).

Myxobolus poljanski Shul'man 1962: This parasite was recorded from *C. luteus*. The first report on this parasite in Iraq was from *B. grypus* from Dokan Dam Lake (2). Later on, it was reported from three other fish hosts in Iraq (33) which included *C. luteus* (reported as *B. luteus*) from Hemrin Dam Lake (18).

Myxobolus sphaericus (Fujita, 1924): This parasite was recorded from *C. luteus*, *C. macrostomum* and *L. abu*. Its first record in Iraq was from *C. regium* from Tigris River at Salah Al-Dien province (1). Later on, it was reported from six other fish species in Iraq (33) which included *L. abu* from Dokan Dam Lake (2). So, both *C. luteus* and *C. macrostomum* of the present study represent two new host records for this parasite in Iraq (33).

Unicauda lumae Rahemo, 1976: This parasite was recorded from *C. carpio*, *C. macrostomum* and *L. abu*. Its first record in Iraq, as *species de novo*, was from *B. grypus* from Tigris River at Mosul (38). No more hosts were reported for *U. lumae* in Iraq (33). So, *C. carpio*, *C. macrostomum* and *L. abu* of this study represent three new host records for this parasite in Iraq.

To sum up on the myxosporean infections of fishes of the present study, *Myxobolus pfeifferi* was the prevalent parasite among these fishes as it was recorded here from eight fish hosts, followed by *M. oviformis* which was reported from five parasite species and only one host was recorded for six myxosporeans. However, no infection was reported from both *A. caeruleus* and *A. vorax*. Dealing with the host specificity, it seems from Table (2) that six species (*C. wardi*, *M. rhodei*, *M. koi*, *M. mesopotamiae*, *M. nemachili* and *M. poljanski*) occurred in only one hosts for each. On the other hand, *L. abu* was infected with 15 different myxosporeans and *C. luteus* was infected with the highest number (16 species). It is difficult to attribute these infections to host specificity (42) due to the few number of fish samples available. In connection with differences in the infection among fishes from the three sampling areas, table (2) indicates that fishes of Al-Taji were infected with 16 species, those of Al-Zaafaraniya with 15 species while those of Al-Shawaka were infected with 12 species. These numbers are, to some extent, in accordance with number of fishes sampled (Table 1). In general, more fish examined usually reveal more parasitic infections. Hence, to get reliable results, many fish specimens should be examined.

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Table (1). Number of the examined fishes from three stations at Tigris River.

Fish scientific name	No. fish examined from: Al-Taji	Al-Shawaka	Al-Zaafaraniya	Total
Alburnus caeruleus Heckel, 1843	1	-	-	1
Aspius vorax Heckel, 1843	2	-	-	2
Carasobarbus luteus (Heckel, 1843)	21	3	9	33
Carassius auratus (Linnaeus, 1758)	-	-	1	1
Carassius carassius (Linnaeus, 1758)	6	2	11	19
Cyprinus carpio Linnaeus, 1758	8	4	3	15
Cyprinion macrostomum Heckel, 1843	7	1	3	11
Liza abu (Heckel, 1843)	11	26	28	65
Mystus pelusius (Solander, 1794)	-	1	-	1
Silurus triostegus Heckel, 1843	-	6	-	6
Total	56	43	55	154

Table (2). Infection of fishes from Tigris River at Al-Taji (T), Al-Shawaka (S) and Al- Zaafaraniya (Z) with 20 parasite species of the Class Myxosporea with their site of infection and percentage of incidence.

Parasite species	Host species	Site of infection*	% Incidence	Sampling area		
				T	S	Z
Chloromyxum wardi	*+ C. luteus*	G	3	√		
Myxidium pfeifferi	*C. luteus*	L	3	√		
	+ L. abu	O	1.5			√
Myxidium rhodei	*C. carpio*	K	6.6	√		
Myxobolus bramae	*C. luteus*	H, K, L, S, Sp	18.1	√		√
	+ L. abu	H, K, L, S, Sp	4.6			√
M. cyprinicola	*C. carpio*	G, S	13.3	√	√	
	+ C. luteus	K	3	√		
	+ C. macrostomum	S	9	√		
	+ L. abu	G, H, I, K, L, O, S, Sp	53.8	√	√	√
M. dispar	*C. carassius*	S	5.2		√	
	C. luteus	G, K, L, S, Sp	9	√		√
	L. abu	G, H, K, L, O, Sp	9.2		√	√
M. dogieli	*+ C. carassius*	G	5.2			√
	C. luteus	K, Sp	3			√
	L. abu	Sp	3	√		√
M. drjagini	*+ C. carassius*	G, Sp	10.5	√	√	
	C. luteus	G, H, K, L, O, S, Sp	54.5	√		√
	+ C.macrostomum	G, K, L, Sp	9	√		
	+ L. abu	G, H, K, L, O, S	12.3		√	√
M. koi	*C. luteus*	K	3		√	

M. macrocapsularis	*C. luteus*	G, K, Sp	9			√
	+ L. abu	S	1.5			√
M. mesopotamiae	*+ L. abu*	L	1.5			√
M. mülleri	*+ C. carassius*	G, H	5.2		√	
	L. abu	G, L, S	4.6	√		√
M. musculi	*+ C. luteus*	G, K, L, S	18.1	√		√
	+ C. carpio	G, K, S	12.5			√
	+ L. abu	G, H, K, L, S	10.7		√	√
	+ S. triostegus	L	16.6		√	
M. nemachili	*C. luteus*	G, K, L, Sp	12.1	√		√
M. oviformis	*C. carassius*	S	5.2	√		
	C. luteus	G, H, K, L, S, Sp	21.2	√	√	√
	C. carpio	S	6.6		√	
	L. abu	G, K, L, S	6.1		√	√
	+ S. triostegus	G , L	33.3		√	
M. parvus	*+ C. luteus*	S	3	√		
	C. carpio	G, S	13.3		√	
	+ L. abu	G, H, I, K, L, O, S, Sp	44.6	√	√	√
	+ S. triostegus	S	50	√	√	
M. pfeifferi	*+ C. auratus*	G	100			√
	C. carassius	G, S	10.5	√	√	
	C. luteus	G, K, L, S, Sp	24.2	√		√
	C. macrostomum	S	9	√		
	C. carpio	S	6.6	√		
	L. abu	G, H, I, K, L, O, S	16.9	√	√	√
	M. pelusius	K	100		√	
	S. triostegus	S	16.6		√	
M. poljanski	*C. luteus*	K	6		√	
M. sphaericus	*+ C. luteus*	S	12.1	√		
	+ C. macrostomum	S	9	√		
	L. abu	G, H, I, K, L,O, S, Sp	12.3		√	√
Unicauda lumae	*+ C. carpio*	G	12.5	√		
	+ C.macrostomum	G	9			√
	+ L. abu	L	1.5		√	

* Site of infection: G= Gills, H= Heart, I= Intestine, K= Kidneys, L= Liver, O= Ovaries, S= Skin, Sp= Spleen.

+ New host record in Iraq.

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البوغيات المخاطية (شعبة الحيوانات المخاطية) المتطفلة على أسماك نهر دجلة شمال ووسط وجنوب محافظة بغداد، العراق

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الخلاصة. ما بين شهري كانون الثاني وكانون الأول من عام 2009 تم جمع وفحص 154 نمودجاً من أسماك نهر دجلة من ثلاث محطات شمال ووسط وجنوب محافظة بغداد (التاجي، الشواكة والزعفرانية). تعود تلك الأسماك إلى عشرة أنواع هي اللصاف، الشلك، الحمري، السمكة الذهبية، الكرسين، الكارب الإعتيادي، البنيني الكبير الفم، الخشني، أبو الزمير والجري الآسيوي. خلال الفحص المختبري تبين أن ثمانية أنواع من هذه الأسماك كانت مصابة بعشرين نوعا من طفيليات صنف البوغيات المخاطية. شملت هذه نوعا واحدا من الجنس *Unicauda* ونوعا واحدا من الجنس *Chloromyxum* ونوعين من الجنس *Myxidium* و16 نوعا من الجنس *Myxobolus*. من بين هذه الأنواع المتطفلة، أصاب النوع *Myxobolus pfeifferi* أكبر عدد من المضيفات (ثمانية مضيفات) بينما سجلت إصابة ستة أنواع من تلك الطفيليات لمضيف واحد فقط لكل منها. ومن بين الأسماك، كانت سمكة الحمري مصابة بأعلى عدد من أنواع الطفيليات (16 نوعا) تلتها سمكة الخشني المصابة بـ 15 نوعا في حين لم تسجل أية إصابة بكل من سمكتي اللصاف والشلك. كما تم تسجيل 27 مضيفاً جديداً في العراق لـ 15 نوعاً من هذه الطفيليات.