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Variations of the Infection of the Mugilid Fish *Liza abu* (Heckel, 1843) with the Acanthocephalan *Neoechinorhynchus iraqensis* Amin, Al-Sady, Mhaisen *et* Bassat, 2001

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Abstract

During the period from October 2002 till September 2003, a total of 296 specimens of the mugilid fish *Liza abu* were collected from different fish markets at Baghdad city. The inspection of these fishes revealed the presence of the acanthocephalan *Neoechinorhynchus iraqensis* in their intestine. The overall percentage incidence of infection was 37.2% and the mean intensity of infection was 2.1. The infection of male and female fishes showed no significant differences. Generally, the percentage incidence of infection was high during spring and first two months of summer, while lower values were recorded during autumn. The mean intensity was generally high during winter and spring and low during summer and autumn. Significant differences in the percentage incidence were noticed in different fish length groups. The percentage incidence gradually increased with the increase in fish length, reached its highest value in length group 140-149 mm, and then it decreased until it reached its lowest value in the largest length group of 170 mm and more. No significant differences were noted in the mean intensity of infection of different fish length groups. Generally, the intensity was higher in smaller fishes and lower in larger fishes.

Keywords

Liza abu, *Neoechinorhynchus iraqensis*, Incidence of Infection, Intensity of Infection, Fish Length and Sex, Monthly Variations

1. Introduction

The acanthocephalans (thorny - or spiny - headed worms) are easily recognized because of their proboscis, which bears chitinoid hooks (Smyth, 1962). These elongated worms, with non- segmented bodies, have neither alimentary canal nor circulatory system. They are of separated sexes, males being shorter than females and characterized by their cement glands and copulatory bursa (Hoffman, 1999). The adult acanthocephalans suck host digested food directly through their teguments, may block host intestine in cases of heavy infection (Khamees, 1983; Jithendran and Kannappan, 2011; Sanil *et al.*, 2011; Rajeshkumar *et al.*, 2013) and cause diverse pathological changes in the intestine of their hosts (Hasan, 2004; Lefebvre *et al.*, 2012; Amin *et al.*, 2015). According to Amin (2013), number of acanthocephalan taxa reached 26 families, 157 genera and 1298 species.

The acanthocephalan *Neoechinorhynchus iraqensis* was detected for the first time by Al-Sady (2000) and was described and published as a new species from *L. abu* from the Euphrates River (Amin *et al.*, 2001). Mhaisen (2002) indicated that *N. agilis* which was recorded for the first time in Iraq by Habash and Daoud (1979) represented a misidentification and the total of 29 of its records from 15 freshwater fishes from mid and south Iraq are considered as synonym of *N. iraqensis*. So far, *N. iraqensis* and its synonym in freshwater fishes of Iraq have 17 fish hosts

(Mhaisen, 2015).

The relationship between infection parameters with the acanthocephalans and their host aspects revealed different forms. Among concerned studies dealing with *Neoechinorhynchus* species in Iraq are those of Al-Hadithi *et al.* (1980), Khamees and Mhaisen (1988), Mhaisen *et al.* (1988), Ali *et al.* (1989), Al-Awadi (1997), Al-Alusi (1998), Al-Niaeem (1999), Al-Jadoaa (2002), Al-Sady *et al.* (2003), Al-Saadi (2007) and Taher *et al.* (2009). The present article was undertaken to demonstrate the relationships between the infection parameters (percentage incidence and mean intensity) of *N. iraqensis* with sex and length of its host *L. abu* as well as the seasonal changes in these infection parameters.

2. Materials and Methods

A total of 296 specimens of *L. abu* were collected during the period from October 2002 till September 2003 from fish markets of Baghdad city. According to fish sellers, these were captured from the nearby canals and drainages at southwest Baghdad city. In the laboratory, fish total length and total weight were measured. Upon dissection, they were sexed and examined for parasites according to Amlacher (1970). Prevalence of infection and mean intensity of infection were calculated according to Margolis *et al.* (1982). Parasite identification was done according to Amin *et al.* (2001).

Student t-test was applied to demonstrate any differences in the infection of both sexes of the fish, while Chi square (χ^2) test, was applied to demonstrate any significant differences in the infection of different fish length groups and changes of infection during different months (Campbell, 1967).

3. Results and Discussion

Tables (1 & 2) demonstrate the monthly changes of infection parameters of male and female *L. abu* with *N. iraqensis*. No significant differences were noticed in the percentage incidence and mean intensity of infection with this parasite among male and female fishes as the calculated t value was 0.138 and the tabulated value was 2.201 in case of the percentage incidence of infection against a calculated value of 1.394 and a tabulated value of 2.201 in case of the mean intensity of infection. For this reason, data of both sexes were pooled in Table (3).

Table (1). *Monthly changes in the percentage incidence and mean intensity of infection of male L. abu with N. iraqensis.*

Months	Number of examined fishes	Number of infected fishes	Number of parasites	Percentage incidence (%)	Intensity of infection
October 2002	8	3	4	37.5	1.3
November	10	4	7	40.0	1.8
December	7	2	5	28.6	2.5
January 2003	11	3	10	27.3	3.3
February	8	2	7	25.0	3.5
March	12	5	16	41.7	3.2
April	10	4	17	40.0	4.3
May	15	7	15	46.7	2.1
June	19	9	16	47.4	1.8
July	17	8	9	47.1	1.1
August	11	3	5	27.3	1.7
September	14	4	4	28.6	1.0
Total (Average)	142	54	115	(38.0)	(2.1)

Table (2). *Monthly changes in the percentage incidence and mean intensity of infection of female L. abu with N. iraqensis.*

Months	Number of examined fishes	Number of infected fishes	Number of parasites	Percentage incidence (%)	Intensity of infection
October 2002	9	4	6	44.4	1.5
November	8	3	5	37.5	1.7
December	11	3	5	27.3	1.7
January 2003	13	3	3	23.1	1.0
February	16	4	6	25.0	1.5
March	11	5	8	45.5	1.6
April	15	7	20	46.7	2.9
May	17	9	23	52.9	2.6
June	14	6	18	42.9	3.0
July	15	6	11	40.0	1.8
August	11	4	6	36.4	1.5
September	14	2	2	14.3	1.0
Total (Average)	154	56	113	(36.4)	(2.0)

The similarity of infection of both sexes of *L. abu* with *N. iraqensis* was also demonstrated by other workers on different *Neoechinorhynchus* species such as *N. agilis* from *L. abu* (reported as *Mugil hishni*) from Shatt Al-Arab River (Al-Hadithi *et al.*, 1980), *N. agilis* from *L. abu* from Babylon fish farm (Ali *et al.*, 1989), *N. agilis* from *L. abu* from Bahr

Al-Najaf Depression (Al-Awadi, 1997), *N. agilis* from *L. abu* from Alus region of the Euphrates River (Al-Alusi, 1998), *N. agilis* from *L. abu* from Garmat Ali River, Basrah (Al-Niaeem, 1999), *N. agilis* from *Carasobarbus luteus* from Mehaijeran Creek, Basrah (Khamees and Mhaisen, 1988), as well as *N. iraqensis* from both *Leuciscus vorax* (reported as *Aspius vorax*) and *L. abu* from Al-Husainia Creek of Karbala province (Al-Saadi, 2007), *N. iraqensis* from *L. abu* from different fishing grounds in Al-Najaf province (Taher *et al.*, 2009), *N. rutili* from *L. abu* from Al-Husainia Creek of Karbala province (Al-Saadi, 2007), *N. saginatus* from the fallfish *Semotilus corporalis* from Oyster River of New Hampshire, USA (Muzzall and Bullock, 1978), *N. limi* from the central mudminnow *Umbra limi* from a Michigan river (Muzzall, 1984) as well as six *Neoechinorhynchus* species from 22 lake fishes from Wisconsin (Amin, 1986). The infection with some other acanthocephalans also showed that the infection of both sexes of different fish species showed no significant differences such as the infection of the broad whitefish *Coregonus nasus* with *Metechinorhynchus salmonis* in Bothnia Bay in Finland (Valtonen, 1980) and the infection of *Luciobarbus xanthopterus* (reported as *Barbus xanthopterus*) with *Pomphorhynchus spindletruncatus* from Lesser Zab River of north Iraq (Abdullah and Mhaisen, 2007).

The absence of any difference in the infection of both sexes of *L. abu* with *N. iraqensis* of the present investigation is due to the fact that both male and female *L. abu* live in the same habitat on one hand and there are no significant differences in quality and quantity of food consumed by both sexes on the other hand (Yousif, 1983; Al-Alusi, 1998; Al-Asadiy *et al.*, 2001; Al-Saadi, 2007).

Table (3) demonstrates the monthly changes in percentage incidence and mean intensity of infection of both sexes of *L. abu* with *N. iraqensis*. The percentage incidence showed slight decline from November and reached its minimum value (25%) during January and February. A sharp increase was noticed during March and continued till May when it reached its maximum value of 50%. This was followed by a slight decrease during June and July. An obvious decrease occurred during August and followed during September when a minimum value of 21.4% was recorded. So, the percentage incidence was generally high during spring and first two months of summer. The changes in the mean intensity of infection was generally low (1 - 1.7 worms/ infected fish) during July, August and autumn months and slightly high during the other months with a maximum value of 3.4 worms/ infected fish during April.

This pattern of the seasonal variations in the of infection of *L. abu* with *N. iraqensis* is, to some extent, similar to those demonstrated for *N. agilis* (a misidentification of *N. iraqensis*) from the same fish from Shatt Al-Arab River (Al-Hadithi *et al.*, 1980), from Bahr Al-Najaf Depression (Al-Awadi, 1997), from Alus region of the Euphrates River (Al-Alusi, 1998), from Al-Diwania River (Al-Jadoaa, 2002), from Al-Husainia Creek of Karbala province (Al-Saadi, 2007) and from different fishing grounds in Al-Najaf province (Taher *et al.*, 2009).

The increase in percentage incidence and mean intensity of infection of *L. abu* with *N. iraqensis* during spring and first two months of summer can be attributed to the increase in the feeding rate of *L. abu* during this period of the year. Such increase in feeding intensity of *L. abu*, which is related to the changes in water temperature, was demonstrated by some other investigators in different water bodies in Iraq (Yousif, 1983, Al-Alusi, 1998; Al-Asadiy *et al.*, 2001; Al-Saadi, 2007).

Table (3). *Monthly changes in the percentage incidence and mean intensity of infection of both male and female L. abu with N. iraqensis.*

Months	Number of examined fishes	Number of infected fishes	Number of parasites	Percentage incidence (%)	Intensity of infection
October 2002	17	7	10	41.2	1.4
November	18	7	12	38.9	1.7
December	18	5	10	27.8	2.0
January 2003	24	6	13	25.0	2.2
February	24	6	13	25.0	2.2
March	23	10	24	43.5	2.4
April	25	11	37	44.0	3.4
May	32	16	38	50.0	2.4
June	33	15	34	45.5	2.3
July	32	14	20	43.8	1.4
August	22	7	11	31.8	1.6
September	28	6	6	21.4	1.0
Total (Average)	296	110	228	(37.2)	(2.1)

The relation between the changes of the percentage incidence and mean intensity of infection of *L. abu* with *N. iraqensis* in relation with fish length groups is demonstrated in Table (4). A gradual increase in the percentage incidence occurred with increasing fish length until it reached a maximum rate of 51% in length group 140-149 mm. Then, this incidence showed a decrease until it reached a minimum of 17.4% in the bigger length group (170 mm and more). Chi square (χ^2) test indicated a large significant difference in percentage incidence of infection of the different length groups as the calculated χ^2 value was 30.4 while the tabled χ^2 value was 24.32 under the probability level of 0.001. These results agree with some other results of the infection of *L. abu* with *N. iraqensis* and the misidentified *N. agilis* in different inland waters in Iraq such as those of Al-Hadithi *et al.* (1980) from Shatt Al-Arab River, Mhaisen *et al.* (1988) from Mehaijeran Creek south of Basrah city, Ali *et al.* (1989) from Babylon Fish Farm, Al-Awadi (1997) from Bahr Al-

Najaf Depression, Al-Alusi (1998) from Alus region of Upper Euphrates River, Al-Sady (2000) from Al-Faluja region of Al-Anbar province, Al-Saadi (2007) from Al-Husainia Creek of Karbala province and Taher *et al.* (2009) in different fishing grounds in Al-Najaf province.

Table (4). *Changes in the percentage incidence and mean intensity of infection of L. abu with N. iraqensis in relation to fish length groups.*

Fish length groups (mm)	Number of examined fishes	Number of infected fishes	Number of parasites	Percentage incidence (%)	Intensity of infection
Less than 110	17	4	13	23.5	3.3
110-119	30	8	18	26.7	2.3
120-129	32	12	28	37.5	2.3
130-139	45	22	42	48.9	1.9
140-149	51	26	46	51.0	1.8
150-159	55	22	48	40.0	2.2
160-169	43	12	26	27.9	2.2
170 and more	23	4	7	17.4	1.8
Total (Average)	296	110	228	(37.2)	(2.1)

The increase in the percentage incidence of *N. iraqensis* with increasing fish lengths up to 149 mm is attributed to the zooplanktonic feeding of *L. abu* during its smaller sizes. The zooplankton includes the crustaceans which are the intermediate hosts for the acanthocephalans (Olsen, 1974). As *L. abu* grows up, it changes to the omnivorous and then to the herbivorous feeding (Yousif, 1983; Al-Asadiy, 1996). The overall percentage incidence (37.2%) and mean intensity (2.1 worms/ infected fish) as indicated in Table (4) cannot help in attributing the decrease of infection to heavily infected fishes.

Changes in the mean intensity of infection of *N. iraqensis* in different length groups of *L. abu* (Table 4) showed no any significant differences as the value of calculated χ^2 was 0.67 while the tabulated χ^2 value was 24.32 at the probability level of 0.001. The highest mean intensity (3.3 worms/ infected fish) was reported from the lowest fish length group (less than 110 mm). A gradual decrease in mean intensity was followed in the next fish length groups which reached its minimum value (1.8 worms/ infected fish) in length group 140-149 mm. A slight increase was followed in the next bigger groups. The absence of significant differences in the intensity of infection of *L. abu* with *N. iraqensis* is attributed to the low overall incidence and intensity (Table 4). The slight decrease in mean intensity with increasing fish length (Table 4) is attributed to the short life span of the acanthocephalans (Yamaguti, 1963) which does not allow for the accumulation of the adult worms in fish intestine. Some researchers attributed similar decrease in the infection of *L. abu* with *N. iraqensis* and the misidentified *N. agilis* in Iraq to the antagonism between *Neoechinorhynchus* sp. and the third larval stages of the nematode *Contracaecum* sp. (Mhaisen *et al.*, 1988; Ali *et al.*, 1989; Al-Awadi, 1997; Al-Alusi, 1998; Al-Sady, 2000; Taher *et al.*, 2009). However, such reason cannot be applied in this investigation as all *L. abu* were free of *Contracaecum* sp. larvae (Hasan, 2004).

4. Conclusions

N. iraqensis is one of the commonest acanthocephalans affecting freshwater fishes of Iraq especially the mugilid fish *L. abu* which is widely distributed in nearly all Iraqi inland water bodies (Coad, 2010). A total of 59 reports are so far documented on the occurrence of this worm in *L. abu* from north, mid and south of Iraq (Mhaisen, 2015).

Generally, in the present study, the overall percentage incidence of infection was 37.2% while the mean intensity of infection was 2.1. Changes in percentage incidence coincided with changes in mean intensity of infection as this is a common phenomenon in fish parasitology (Dogiel, 1961; Kennedy, 1975).

A similarity in the infection of both sexes of *L. abu* with *N. iraqensis* is attributed to the similarity in their food and feeding habits and to their living in the same habitat (Yousif, 1983; Al-Alusi, 1998; Al-Asadiy *et al.*, 2001). Such similarity is common with most parasites passively acquired with food (Kennedy, 1975).

The infection parameters showed clear monthly variations. SPercentage incidence of infection was high during spring and first two months of summer and lower values were recorded during autumn, while the mean intensity was generally high during winter and spring and low during summer and autumn. Such variations are rather similar to those detected from other studies (Al-Hadithi *et al.*, 1980; Al-Awadi, 1997; Al-Alusi, 1998; Al-Jadoaa, 2002; Al-Saadi, 2007, Taher *et al.*, 2009). Monthly changes in the infection parameters are attributed to changes in water temperature and hence the related changes in fish feeding intensity (Yousif, 1983, Al-Alusi, 1998; Al-Asadiy *et al.*, 2001; Al-Saadi, 2007).

The percentage incidence of infection showed significant differences in different fish length groups. It gradually increased with the increasing fish length up to length group 140-149 mm, and then decreased until it reached its lowest value in the largest fish length group. The mean intensity of infection showed no significant differences in different fish length groups. Generally, the intensity was higher in smaller fishes and lower in the larger fishes. Such decrease in infection parameters can be attributed to the short life span of acanthocephalans (Yamaguti, 1963). However, some studies (Mhaisen *et al.*, 1988; Ali *et al.*, 1989; Al-Awadi, 1997; Al-Alusi, 1998; Al-Sady, 2000; Taher *et al.*, 2009) attributed

such decrease to the antagonisms between the acanthocephalans and the third larval stages of the nematode *Contracaecum* sp., but such reason cannot be applied to the present investigation as no infection with *Contracaecum* sp. was recorded in *L. abu*.

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