PATTERN OF DAUGHTER SPOROCYST (DIGENEA, FAUSTULIDAE) INFESTING *TAPES DECUSSATA* (L.) (BIVALVE, VENERIDAE) FROM THE MEDITERRANEAN

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Abstract

A total of 1262 clams (*Tapes decussata*) were examined, from Port Said coastal zone. Of these, 85 (6.7%) clam *Tapes decussata* were taken at monthly intervals between May 2009 and June 2010 to demonstrate variations in percentage infection by *Cercaria lata* (Faustulidae) with season, and size of host. sizes and season are the main important in determining the percentage infection by *Cercaria lata*. The maturity of the infection and the mean number of metacercariae per daughter sporocyst from the same host are also largely determined by season. Summer months reveal high peaks of infection, which are more than triple the mean percentage infection, occur in March or April . Parasites were the lowest in winter months. In emerging from the host, *Tapes decussata*, the cercariae are expelled through the excurrent siphon. They swim about in the sea water with the body folded upon itself. *Cercaria lata* characterized by Excretory vesicle Y-shaped with long arms reaching anterior to intestinal bifurcation. Tail tubule communicating with bladder. Surface of tail lacking spines provided with annular folded membranes. Twenty-five pairs (24–27) of setae bundles arranged laterally along the tail.

INTRODUCTION

Cercaria lata (Digenea, Faustulidae), discovered by Lespe´s (1857) in *Tapes decussata* (L.) in the basin of Arcachon, was found for the first time, from the eastern Mediterranean in the same lamellibranch

from Tunisia (Bizerte and Tunis lagoons and Gulf of Gabes) Gargouri Ben Abdallah *et al.,* (2008).. The ecology of Digenea from marine molluscs has been studied by few authors including Bartoli (1974), Berry (1962), Bowers (1969), Crewe (1951), James *et al.*,(1977), Palombi (1937) and Wright (1956). *Tapes decussata* represents the first intermediate host and also, in certain cases, the second host. mollusc plays, indeed, a very important role in the lifecycle of several of these platyhelminths (Bartoli, 1974; Hanafy *et al.,* 1997,Gargouri Ben Abdallah, 2001; Gargouri Ben Abdallah &Maamouri, 2001, 2005; Trigui El Menif *et al.,* 2004). The study is an investigation into the factors which determine the occurrence and distribution of the Faustulidae *C. lata* . Also this bivalve can shelter various species of Protozoa and metazoan parasites. Among the Metazoa, digenean parthenitae are the most frequent parasites. The cercariae, assigned to the family the faustulid may be released through the birth pore, escape from the primary host and penetrate an intermediate host or may encyst within the brood chamber of the daughter sporocyst. We limit our study to the sporocysts and cercariae and metacercaria of *C. lata*. As indicated in the literature, this cercaria has been generally believed to be the same as the others collected from various bivalve hosts. This work aimed to through a light on other enemy of bivalves to demonstrate variations in percentage infection by *C. lata* (Faustulidae) with season and shell of clam.

MATERIALS AND METHODS

Collections of *Cercaria lata* were made at monthly intervals from May 2009 and June 2010 from Port Said coastal zone. Hand picked collections were made so that no clam, particularly the small, were missed. The collections, however, were made with the assistance of the clam of Leigh-on-Sea using a continuous hydraulic clams dredge. All clams, including gaping, dead or dying specimens,

were examined as soon as possible after collection, the age and length being determined before dissection for parasites. The age was determined by counting the growth rings and the length by measuring the greatest distance from the anterior to the posterior extremity. The degree of infestation was assessed by counting the number of daughter sporocysts and the number of fully formed encysted metacercariae within each Daughter sporocyst.

RESULTS

A total of 1262 Clams (*Tapes decussata*) were examined, from Port Said coastal zone (Table 1). Of these, 85 (6.7%) were infested with the daughter sporocysts of *Cercaria lata* in the haemocoel of the digestive gland, gonad and foot. also the result declared that May (8.9%); June (9/.1%) and July (19.3%) are the highest months of infestation followed by August (5.01%).

Table 1. Monthly infestation rate of *Tapes Decussata* with daughter sporocysts.

Month	Clam	% Infection
May 2009	78 (7)	8.9
June	115 (22)	19.3
July	98 (7)	9.1
Aug.	80 (4)	5.01
Sept.	88 (7)	0.80
Oct.	57 (2)	0.83
November	100 (6)	6.1
December	103 (2)	0.19
January 2010	55 (1)	1.8
February	157 (8)	0.51
March	66 (6)	0.71
April	40 (2)	2.5
May	125 (4)	3.52
June	100 (5)	4.0
Total	1262(85)	6.7

Table 2. revealed that, the mean shell length, wet tissue weight of *T.decussata* clam and their relation with monthly prevalence of *C. lata* have the most fundamental relation. Where lengths of *T. decussata* collected were ranged from 13.4 to 52.4 mm, (32.1) mm. The intensity of sporocysts ranged from 0 to 21 (11). However, individuals with shell lengths below 29 mm harbor no or very few sporocysts, whereas intensity increases rapidly with increase of shell length also with highly active larger individuals. In respect to seasonal variations, percentage of infection are statistically significant at Port Said coastal zone. Summer months reveal high peaks of infection, which are more than triple the mean percentage infection, occur in March or April . Parasites were the lowest in winter months .

Table 2. Mean shell length, wet tissue weight of *T.decussata* clam and monthly prevalence of infection *C. lata* .

Sampling date	**Samples**	**Shell length (mm)**	**Tissue weight (g)**	**Cercaria infection**	
Month	**Clam**			**No**	**Prevalence (%)**
May 2009	103 (2)	35.6 ±4.2	1.71 ±0.81	4	8
June	115 (2)	34.2 ± 2.9	1.47 ±0.42	4	8
July	98 (7)	31.0 ±2.1	1.16 ±0.37	1	2
Aug.	157 (8)	28.7 ± 3.1	1.18 ±0.46	6	1
Sept.	88 (7)	33.7 ±5.3	1.92±0.99	0	6
Oct.	57 (11)	27.6 ±4.2	1.44 ±0.59	5	0
November	100 (6)	32.3 ±4.5	1.09±0.47	4	8.2
December	78 (7)	31.1±2.9	1.50 ± 0.38	4	3
January 2010	55 (1)	31.5 ±3.3	1.10 ±0.38)	0	2
February	80 (4)	30.6 ±4.5	1.04 ±0.57)	3	3
March	66 (6)	32.1 ±4.5	1.09 ±0.51)	1	2
April	40 (1)	32.7±3.4	1.09 ± 0.37	0	4
May	125 (4)	34.5 ±2.0	1.16 ±0.56	2	7
June	100 (4)	29.5 ±3.0	1.16 ±0.56	2	1

Fig. 1. Clams, *Tapes decussate*

Fig. 2. Sporocysts exhibited white nodules in the digestive gland, gonads and foot of *T.decussata*

The Sporocyst (Fig. 3):

The sporocysts are simple, sac-shaped or tubular structures having at each end a concentration of cells. Otherwise, the walls of the sporocyst are very thin. Young sporocysts containing no germ balls or cercariae are approximately 0.20 mm. in length by 0.09 mm. in width. Older sporocysts containing 12 to 18 germ balls and cercariae are 0.58 mm. in

length by 0.09 mm. in width, indicating that the growth of the sporocyst is principally in length.

A **B**

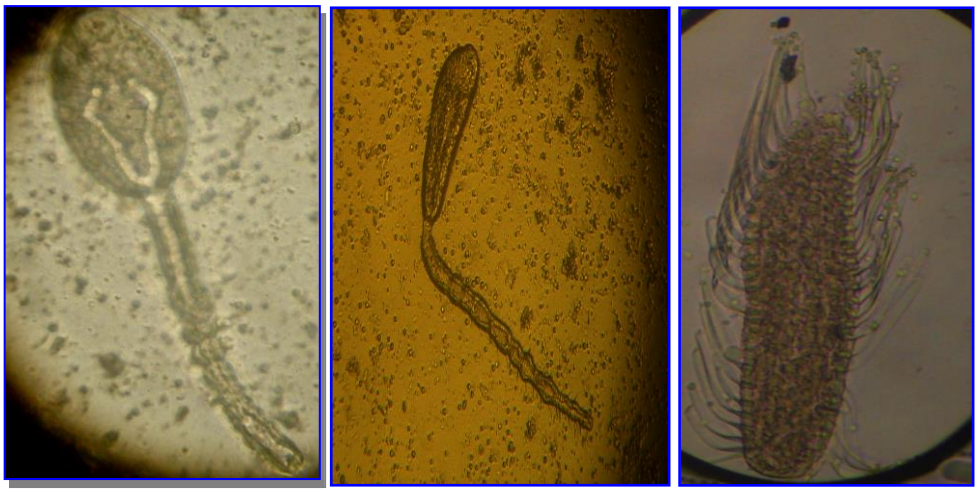
Fig. 3. Mother (A) and daughter (B) sporocysts of *Cercaria lata*.

The Cercaria (Fig. 4):

Excretory vesicle Y-shaped with long arms reaching anterior to intestinal bifurcation. Two lateral collecting ducts opening into anterior extremity of bladder. Tail tubule communicating with bladder. Surface of tail lacking spines provided with annular folded membranes. Twenty-five pairs (24–27) of setae bundles arranged laterally along the tail. Spination is limited to the cuticula of the anterior half of the body and a small area on the ventral surface nears the posterior end. The body is oval, varying in length and width with the degree of contraction. There are two conspicuous eye spots on the dorsal surface near the level of the pharynx. The oral sucker is subterminal and slightly smaller than the ventral sucker which is located in the mid ventral region of the body. The oral sucker is followed by a short prepharynx, a bulbous pharynx, a well-developed esophagus, and short intestinal crura which do not extend posterior to the ventral sucker. The excretory bladder is simple and sac-shaped and its wall is composed of a single layer of large granular cells. In emerging from the host, *T. decussata*, the cercariae are expelled through the excurrent siphon.

Table 3. Cercariae measurements (mm) from *Tapes decussate.*

Body	248 (200–285)
Body breadth	146 (120–160)
Tail	382 (315–430)
Setae bundles	87 (70–110)
Oral sucker	50 (45–60)
Breadth oral sucker	45 (33–55)
Ventral sucker	44 (35–55)
Breadth ventral sucker	42 (30–55)
Pharynx	28 (18–33)
Pharynx breadth	23 (15–27)
Esophagus	40 (30–50)
Caeca	76 (60–90)



A B C

Fig. 4. *Cercaria lata* (a) from *Tapes decussata* (A) Relaxed ; Active swimming (B) and Detached tail with Twenty-five pairs (24–27) of setae bundles arranged laterally along the tail (C).

Metacercaria (Fig.5):

Metacercariae with body oval, vermiform in some live samples from 121-191 µm length, pyriform, 83-113 µm (98±0.011) in width (Fig.5). The body becomes more elongated with protruding oral sucker in Active swimming (B). Tegument spinous; spines embedded in tegument, with triangular extremity protruding, concave, abundant, arranged in radial verticils; contiguous verticils with somewhat alternate series of spines. Anterior black disgorged eyespot pigment observed encircling pharynx. Oral sucker subterminal, oval, larger than ventral sucker. Nine radial globular to triangular papillae, internal rim with 1-3 non-organized series of spines; oral sucker 30-42 µm (42± 0.004) in length, 30-44 µm (43 ± 0.003) in width Mouth in the middle of oral sucker, with conspicuous muscular walls (Fig. 5). Muscular pharynx well-developed in the third anterior end, 26-36 µm (31 ± 0.003) in length, 22-30 µm (26 ± 0.003) in width, with narrow alimentary canal (Figs. 4, 7), followed by a small esophagus. Pseudoesophagus present (30-40 µm in length) larger than esophagus (15-20 µm long). Caecal bifurcation behind esophagus, anterior to acetabulum. Two long lateral intestinal caeca, reaching posterior end, joining excretory vesicle to form uroproct (Fig. 5). Ventro-median acetabulum, 30-41 µm (36± 0.003) in length,32-41 µm (38± 0.003) in width (Figs. 5). Excretory vesicle tubular with spherical concretions bodies, extending from hindbody to the anterior edge of the acetabulum (Figs. 5). Excretory pore terminal with glandular sphincter. Primordia of the testis, oval, contiguous in mid-hindbody. Well developed cirrus sac present, with internal seminal vesicle and overlapping with the ventral sucker. Ovary oval with irregular edges in some specimens).

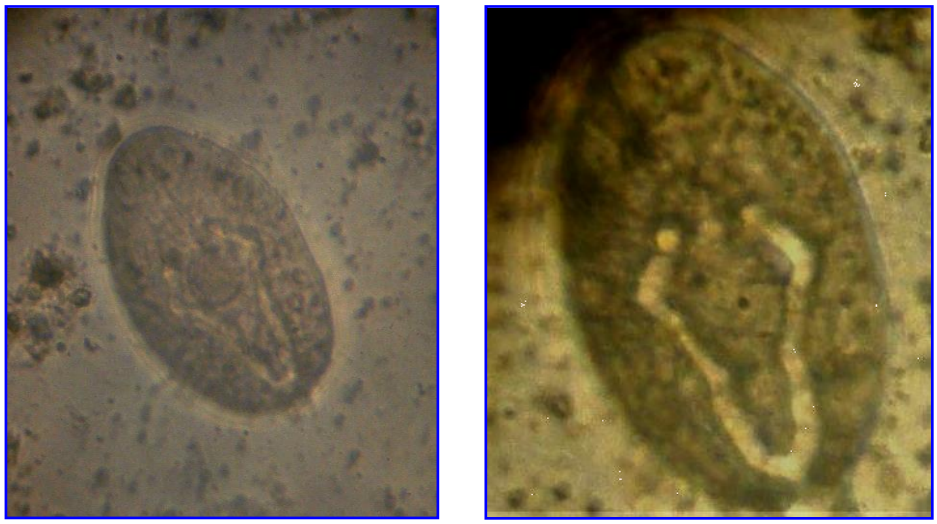


Fig. 5. Metacercaria

DISCUSSION

In this work the researcher found that, *C. lata* infest *T. decussate* (Bivalve, Veneridae) in Port Said coastal zone, possessing a spined tegument, a trichocercous tail without furcae, provided with Twenty-five pairs (24–27) of setae bundles arranged laterally along the tail and a Y-shaped excretory system, belongs to subfamily Baccigerinae. *Cercaria lata* was first described by Lespe´s, 1857 in the same mollusc taken from the basin of Arcachon. The original description of this cercaria, limited to the digestive system and some elements of the excretory system, lacks any relevant information on the cephalic glands, the reproductive system, the number of flame cells, the setae bundles and the rib-like supports of *C. lata.* Palombi (1934) found in *T. decussata*, collected from Naples, a 'Steringophoridae' cercaria and considered it *Bacciger bacciger*. This was based only on the morphological similarity of the larval stage with the adult, and the life cycle of this species was described as: cercariae after escaping from sporocysts parasitizing the first intermediate host, *T. decussata*, penetrate and encyst as metacercariae in the Amphipoda *Erichthonius difformis*, and develop into adults in the alimentary tract of

Atherina spp. Later, Palombi (1934) reported cercariae which appear to be the same species in other bivalve hosts (*Venerupis aurea* (Veneridae), *Chameleagallina* (Veneridae), *Donax vittatus* (Donacidae) and Barneacandida (Pholadidae)) and also attributed them to *Bacciger bacciger*. The Baccigerinae Yamaguti, 1959 was considered as the junior synonym of the Faustulidae, Poche, 1926. Sannia *et al.*, 1978) reported that in recently infected clams, the daughter sporocysts of *Cercaria lata* contain few encysted metacercariae but in long established, mature infestations many metacercariae. The distribution of the number of fully formed encysted metacercariae per daughter sporocyst in the same clams approaches normality as the infestation matures. Recently, On the basis of molecular, morphological and life cycle data, Hall *et al.* (1999) removed the subfamily Baccigerinae . Later, Ramon *et al.* (1999) reported sporocysts and cercariae of *Bacciger bacciger* in *D. trunculus* (Donacidae).

On the Tunisian coasts, in addition to finding *C. lata* in *T. decussata*, Gargouri Ben Abdallah *et al.* (2008) have found another faustulid cercaria in *T. decussata* and *D. trunculus* and tested the significance of these differences, also submitted the morphometric features to principal components analysis. With about 60 in *C. lata*, these spherules are more numerous and much smaller than in the other cercariae. The number of cercariae within the sporocyst, their emergence behaviour, the size and seasonal incidence are also different. In fact, fewer cercariae (varying from 4 to 17) are found in the sporocysts of *C. lata* than in the sporocysts from *D. trunculus* (8–22) Gargouri Ben Abdallah *et al.* (2008). In addition, the size of the sporocysts from Tapes (at 1450–3600mm) is slightly smaller than those from *Donax* (1700–4200 mm). *Cercaria lata* emerges from the sporocyst by the rupture of the lysed wall; however, cercariae of the other species leave the sporocyst via the birth pore. The highest prevalence of infection was recorded in autumn in *T. decussata* and in summer in *D. trunculus* Gargouri Ben

Abdallah *et al.* (2008). From the Mediterranean coast at Port Said coastal zone in Egypt, Ramadan and Amaal (2010) describe and discuss cercariae and Sporocysts of *Bacciger bacciger* were embedded in gonadal tissue*;* promotes a severe castration in the bivalve *Donax trunculus.*

These results declared that May (8.9%); June(9/.1%) and July (19.3%) are the highest months of infestation followed by August (5.01%) mean that the summer months showed the main infestation period and the Parasites were absent in winter and spring from *T. decussata* . In consequence, the mean number of metacercariae per daughter sporocyst in each clam is not correlated with the number of daughter sporocysts in that clam . Daughter sporocysts within primary host mostly contain metacercariae. Intermediate host becomes infected by cercariae previously (Sannia *et al.,* 1978) are released to find and penetrate the intermediate host and await the return of the final host in the following spring. During autumn and winter daughter sporocysts within the primary host slowly continue to produce cercariae which now fail to leave, metamorphose into metacercariae and encyst within the brood sac (Sannia *et al.,* 1978). The seasonal cycle could be influenced by the reproductive cycle of the primary host, *Tapes Decussata* which may be susceptible to cercarial infection , only in the summer when maturation of the gonads is commencing (Bowers, 1969; James *et al.,* 1977). The probably random distribution of infection within the age and size groups of the primary host is unusual (Berry, 1962; Bowers, 1965; James *et al.,* 1977). Significant variations of percentage infection by *C. lata* occur only with season. Frequently only spent adult molluscs are susceptible to infection and the percentage infection increases with the host's age and size (Bowers, 1969; James *et al.,* 1977) but occasionally only juveniles are susceptible to infection (James *et al.,* 1977). Thus, no accumulation with age is possible. But our study disagreed with the previous studies as the entrance of cercarial

infestation irreversible and no self cure and disagreed with the say that ,very low incidence of infection protects the host population as a whole and the uniform susceptibility to infection retains the balance between age and size groups. As clams of all size groups are equally susceptible to infection, the difference in the shell length between parasitized and healthy clams must be due to inhibition of shell growth by *C. lata* In contrast, infection by digenean sporocysts and rediae frequently causes gigantism in prosobranchs (James *et al.,* 1977). And this study coined with Young and She (1984) whom stated that the infection rate was 100%in June and July , but it decreased in September and October.

Finally ,I think that, the main pattern of infestation are season and age of the clam (shell length). Future studies will need to address specifically the matter of additive versus compensatory mortality implied from the laboratory study.

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أنماط إصابة الطور الحويصلى للديدان ثنائية العائل الفستيوليدبللمحار ثنائي المصراعين من البحر الأبيض المتوسط

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الملخـــــص العربـــــى

تم فى هذه الدراسة تجميع ١٢٦٢عينه من المحار ذوات المصراعين من نوع (التابس ديكساتا) من منطقة بور سعيد. من هذا العدد ظهر ٨٥ بنسبة ٦.٧% مصابة بثنائية العائل الفستيوليدى خلال الفترة من مايو ٢٠٠٩ حتى يونيه ٢٠١٠ ، وقد لوحظ أن أعلى نسبه للأصابه كانت في شهور الصيف فقد كانت النسبة فى شهر مايو (٨.٩%) ويوليو(٩.١%) وكانت النسبة الأعلى في شهر يونيه (١٩.٣%) بينما تهاوت النسبة فى شهر أغسطس إلى ٥.٠١%. كذلك فقد تم دراسة اثر كلا من تأثير الموسم وعمر المحار والتي تتمثل في حجمه على درجة أصابته حيث سجل أن شهور الصيف كانت أكثر من ثلاث أضعاف ما سجل فى أشهر مارس أو ابريل كذلك كانت اقل نسب أصابه لشهور الشتاء.

كذلك تم الوصف الدقيق لسلوك وحركة السر كاريا أثناء خروجها من المحار حيث تخرج من السيفون الخارج وتعوم في المياه حيث تقوم بثني نفسها فيما يشبه حرف 8. وتتميز السر كاريا بأن الحويصلة الإخراجية تشبه حرف Y ولها ازرع طويلة تمتد أماما إلى تفريعات الأمعاء. ويتميز الذيل بخلوه من الحسك والأشواك التي تميز الأنواع الأخرى من السر كاريا ولكنه مزود بغشاء بة ثنيا متعددة كلا منها يحمل حزمه شعرية متراصة على جانبي الذيل وهم حوالي خمس وعشرون زوج (٢٤-٢٧).

كذلك تم وصف الميتاسركاريا والطور الجرثومي الذي يحتوى على السر كاريا والميتاسركاريا.