ISSN: 2356-7767

Investigation of digenesis in some marine fishes in Red Sea

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Received in 16/1/2019
Accepted in 19/2/2019

Abstract

This study was carried on 140 marine fishes 50 *Saurida undosquamis*, 40 *Scombermorus commerson* and 50 *Siganus rivulatus* which were randomly collected from Al-Adabia, Red Sea and examined for presence of digenea. The infested fishes revealed no external visible abnormal signs except some fishes suffered from slight abdominal distension, somewhat emaciation and anemia. The post-mortem findings showed paleness or congestion of the intestine and visceral organs. Enlargement or pale liver and variable degrees of congestion were noticed in some cases. The total prevalence of digenetic trematodes in the examined marine fishes was 32.14%. The highest infestation rate of digenean parasite was recorded in *Saurida undosquamis* (34%) followed by *Siganus rivulatus* (32%) and the lowest infestation was in *Scombermorus commerson* (30%). Five species were isolated and identified as *Aponurus laguncula, Lecithocladium angustiovum*, *Lecithochirium fusiforme, Parantorchis chaetodontis* and *Gyliauchen papillatus.* The morphological description was performed on the structure and the characteristic of each isolate. Infested fishes showed mechanical destruction of the intestinal villi with sloughing of epithelial cells in lumen, necrosis and degeneration of the intestinal villi, some fishes showed hyperplasia of the intestinal villi along with diffuse mucinous degeneration of intestinal epithelium. The liver of some infested fishes showed diffuse vacuolar degeneration of hepatic cells along with congestion of central veins and necrotic changes of some hepatocytes.

Key words: *Marine fishes, Red sea, trematodes, digenean, prevalence, histopathological lesions.*

Introduction

Parasites are acknowledged among the most detrimental effects on fish stocks all over the world. They cause hindrance in growth, reduce fish production by affecting the normal physiology of fish, lead to diseases and may even cause the deaths of whole school of host fish. Just few parasites don't cause noticeable defects on fish, however, when they increased in numbers an increase in ratio of the harm also occur **(Akmirza , 2013)**. Fish parasitology is one of the more interesting branches for many researchers all over the world especially for the marine fishes for describing the new taxa (**Al-Jahdali, 2012 and khasheghbal *et al.*, 2017)** either for the internal or external parasites. Parasites in wild fish are usually only remarked upon when they are so obvious as to lead to rejection of fish by fishermen or consumers **(Roberts, 2012)**

Marine parasites are of immense ecological and economic importance. Almost groups of marine animals including the various invertebrates, fish, marine birds and reptiles, are hosts to parasites (**Rohde, 2006**). The parasite fauna of marine fishes and invertebrates is extremely rich and diverse and has the largest total biomass. Many parasites are highly pathogenic to their hosts, and may affect their number, reduce the quality of raw fish and fish products, or be harmful to human. Digenean trematodes primarily infect gastro-intestinal tract in marine fish, and their life cycle involves two to four hosts (**Barnes 1980, Al-Zubaidy 2010 and Al-Hasawi (2019)**.

Digenetic trematodes represent the largest group of all internal metazoan parasites as they comprise about 18,000 nominal species. Trematodes have complex life cycles, in which a mollusk serves as the first intermediate host and a vertebrate is usually the definitive host **(Al-Zubaidy ,2011)**. According to **Cribb *et al*. (2002)**, Digenea have over 100 families, well over 1000 genera and many thousands of species, many of them are of great importance to marine ecosystems.

The trematodes are considered as important endoparasites of vertebrates and invertebrates **(Díaz-Briz *et al.*, 2012).** The digenea are one of the major taxa of parasitic Platyhelminthes and they are invariably endoparasites. Digeneans are heteroxenous and require more than one host to complete their life cycle. The most important limiting factor for digenean dispersal is the intermediate host such as gastropoda and bivalvia (**Paperna and Dzikowski, 2006 and Akmirza, 2013**). Hemiuridae are a family which comprises the most common parasitic digenean flukes inhabiting the digestive tract of marine fish. Although studies on parasitic worms from Egyptian fish are important in controlling the impact of such parasites on fish health and fish production, relatively little is known on the helminthic fauna of fish in Egypt. **(Abdel-Ghaffar *et al.*, 2013)**

The aim of the present investigation is to determine the presence of digenetic trematodes that influence some marine fishes from Al-Adabia, Red Sea. Examination of clinical picture with the morphological characters of the detected isolates. The histopathological alterations in tissues of naturally infested fishes induced by isolated digenetic trematodes on different organs were described.

Materials and Methods

Fishes:

The present investigation was done using 140 alive marine fishes, 50 *Saurida undosquamis*, 40 *Scombermorus commerson* and 50 *Siganus rivulatus* which were randomly collected from El-Adabia -Red Sea. The collected alive fishes were transported to Ismailia lab in plastic bags partially filled with water according to **Langdon and Jones (2002).**

Clinical picture:

The fishes were examined carefully, externally and internally for detection of any abnormalities. Musculatures, stomach, intestine and other internal organs were submitted for intensive examination for digenetic trematodes according to **Conroy and Hermann (1981).**

Parasitological examination:

The collected digenetic trematodes were washed in distilled water and fixed by 5% formalin between two slides after relaxation and stained with Semichon`s acetocarmine, dehydrated in ascending grades of ethyl alcohol and mounted in Canada balsam according to the methods adapted by **Schmidt (1992)**.

Histopathological examination:

From sacrificed infested fishes, liver, stomach and intestine containing digentic trematodes were fixed in 10% neutral buffered formalin, dehydrated in ascending grades of ethyl alcohol, cleared in xylol and then blocked in paraffin wax. Tissue sections of 5-7 microns thickness were stained with Hematoxylin and Eosin (H&E) according to **Takashima and Hibiya (1995).**

Results and Discussion

Clinical picture:

The clinical signs of most examined infested fishes with digeneaiasis revealed no pathognomonic abnormalities except that some fishes suffered from slight abdominal distension, somewhat emaciation and weakness. The postmortem revealed enlargement and pale liver with variable degrees of congestion. Paleness or congestion of the intestine and internal organs in some cases were noticed. Slight bulging of the stomach, and hemorrhage on the mucous membrane with watery food. **(Plate 1, 2 and 3).** These findings may be due to the effects of the parasites on the gastrointestinal tract resulting in both destruction and alteration of tissue or mechanical blockage of intestinal lumen. The congestion is mainly attributed to the effect of the parasite attachment by its oral and ventral suckers to the intestinal mucosa. These clinical findings are similar to that recorded by **El-lamie (2007), El-Ashram and Shager (2008), Abdel-Mawla and Abo-Esa (2011), Abdel-Mawla and El-Ekiaby (2012), Ahmed (2017) and Eissa *et al.* (2017).**

Parasitological findings: Identification of the parasites was carried out according to **Yamaguti (1971)** and their morphometric features in **Order:** Plagiorchiida
as follows:

Family: Lecithasteridae **Odhner, (1905)**
Subfamily: Leeithasterinae
Genus: Aponurus
Species: *Aponurus laguncula* **Looss, 1907**

The adult worm isolated from the intestine of *Saurida undosquamis*. Small body, narrow, widest near posterior extremity and unarmed Tegument. Pre-oral lobe small or not evident. Oral and ventral sucker subglobular. Pharynx oval. Caeca not easily seen; caecal extremities obscured by eggs; in immature worm and in sections caeca can be seen to reach well into posterior half of post-testicular region. Testes oval; oblique; in anterior hindbody; Seminal vesicle sub-globular, in posterior forebody. Pars prostatica narrow, curved, with relatively few gland-cells. Genital atrium absent. Genital pore median, in anterior forebody. Ovary oval to sub-triangular; posterior to anterior testis and postero-lateral to posterior testis. Seminal receptacle seen only in longitudinal sections. Vitellarium consists of seven irregular follicles immediately posterior to ovary. **(Plate 4: A, B & C)**. This description was similar to that recorded by **Fernandes *et al.* (2009)** from Argentina in *Paralichthys patagonicus*, **Madhavi and Lakshmi (2011)** from Indian mackerel *Rastrelliger kanagurta*, **Al-Zubaidy & Mhaisen (2014)** in Indian mackerel *Rastrelliger kanagurta* from the Red Sea and **Chero *et al.* (2017)** in *Parapsettus panamensis* from the coastal zone of Puerto Pizarro.

Family: Hemiuridae
Genus: *Lecithocladium*
Species: *Lecithocladium angustiovum* **Yamaguti, (1953).**

Isolated from the stomach and intestine of *Saurida undosquamis.* Body elongate, Ecsoma tapered posteriorly, usually extended, short and blunt. Cuticular denticulations present on the entire surface of the body proper. The lateral cuticular folds curve backward in a longitudinal direction at the ventral posterior end of the proper body , so that this small midventral area was covered with smooth cuticle, similar to the ecsoma. Oral sucker terminal, cup-shaped, with a pair of distinct submedian incisions ventrally. Oral sucker is much larger than the ventral sucker. Oesophagus is very short and frequently turned dorsally. Uterus extends into the ecsoma more than half of its length, coiled between the posterior testis and ovary, running in a dorsal or dextral direction, and occasionally in a sinistral direction. Excretory pore terminal, arms uniting the dorsal and posterior end of the oral sucker. **(Plate 4: D)**. This description was similar to that recorded by **Madhavi and Lakshmi (2011)**

Family: Hemiuridae
Genus: Lecithochirium
Species: *Lecithochirium fusiforme* **Lühe, (1901)**

Isolated from the intestine of *Saurida undosquamis*. Body elongate, rounded anteriorly but truncate posteriorly. breadth at ovarian level, ecsoma well developed. Oral sucker subterminal. Ventral sucker circular, large. Prepharynx absent. Pharynx large, oesophagus short, ceaca ending at base of ecsoma. Testes two, symmetrical, spherical, postacetabular.

Ovary spherical, posttesticular. Uterine coils numerous, fell much of somatic hindbody. Vitellarium equatorial, consist of seven lobes **(Plate 4: E)**. This description was similarly to **Akmirza (2013**).

Family: Faustulidae
Genus: Parantorchis
Species: *Parantorchis chaetodontis* **Yamaguti, 1934**
Isolated from the intestine of *Scombermorus commerson*. Body small, oval to fusiform, spinulate. Oral sucker subterminal, pharynx small, esophagus moderately long, ceca half long. Acetabulum moderately large, situated toward midbody. Testes symmetrical, just medial to ceca in front of acetabulum. Genital pore just behind intestinal bifurcation. Ovary is posterior-dorsal to the ventral sucker and slightly to the right of the median line. The oviduct starts from the posterior-median part of the ovary. The large oblong seminal receptacle is located dorsally with respect to the ovary. The vitelline ducts are guided posteriorly along the ventral wall of the intestinal ceca, then bend towards the midline and, passing along the dorsal side of the testes, form a transversely oblong basin of triangular shape medially located between the testes and dorsally with respect to them. The excretory opening is located at the tip of the dorso-terminal protrusion. A bottle-shaped bubble is located between the testes and dorsally from them to bifurcate to lateral collecting tubes. **(Plate 5: A)**. This description was coincided with that recorded by **Cribb *et al.* (1999).**

Super family: Lepocreadioidea
Family: Gyliauchenidae. **Ozaki, (1933)**
Genus: Gyliauchen.
Species: *Gyliauchen papillatus* **Goto and Matsudaira, (1918)**
Isolated from the intestine of *Siganus rivulatus***.** Body crescent shaped in life and orange in color, fixed specimens somewhat convex dorsally, tapering gradually anteriorly, with excretory papilla projecting posterodorsally. Cuticle thick and smooth. Oral sucker globular, slightly subterminal. Ventral sucker globular, near posterior end of body. Prepharynx convoluted, forming 3 or 4 coils, surrounded by glands along entire length. Pharynx oblong to cylindrical, muscular. Esophagus absent. Ceca 2, mostly in midbody third, measuring about one-third to one-fourth of body length. Testes 2, globular, oblique, dorsal to ventral sucker. Seminal vesicle bipartite, parts separated by narrow constriction. Cirrus sac well developed, containing ovoid prostatic vesicle and well-developed, muscular, eversible cirrus. Prostatic cells well developed, surrounding junction of cirrus sac and anterior portion of seminal vesicle. Ovary globular, small compared to testes, dorsal to anterior testis or to junction of 2 testes. Vitellaria follicular, extending from midprepharyngeal region to near anterior level of anterior testis. Uterus preovarian. Genital pore ventral at level of intestinal bifurcation. Excretory bladder with short duct opening at tip of excretory papilla. **(Plate 5: B & C)**. This description was coincided with that recorded by **Al-Jahdali and Hassanine (2012), Al-Jahdali (2012, 2013) and Abd El-Latif and Mohammed (2014).**

Prevalence of the detected digenetic trematodes:
The total prevalence of digenetic trematodes infested in examined marine fishes was (32.14 %.). Which was nearly similar to the results obtained by **El-Labadi *et al.* (2006), El-Ekiaby (2009) and Attia *et al.* (2018)** in which the percentages were 38% from the Gulf of Aqaba, 32.65% in some marine fishes and 33% in sea bass from the Mediterranean Sea, respectively.

Meanwhile, it was higher than that obtained by **Youssef and Derwa (2005)** 6.67% in some fishes from Suez Canal area and **Ahmed (2017)** 17% in some cultured marine fishes. It was lower than that obtained by **El-Ashram and Shager (2008)** 61.3% in some Red Sea fishes.

This variation in prevalence may not only be attributed to the change in the climatic conditions, but also to the differences in species of examined fish, size, feeding habits, sampling periods, species of digenetic parasites and the locality from which fish samples collected.

Table (1) showed the prevalence of trematodes in *Saurida undosquamis* was 34% which was nearly similar to the results obtained by **El-Ekiaby (2009)** 33.3% in *Trachurus mediterraneus*, **Morsy *et al.* (2012)** 37.8% in *Saurida tumbil,* **Al-Zubaidy and Mhaisen (2014)** 32.4% *Aponurus laguncula* in Indian mackerel *Rastrelliger kanagurta* from the Red Sea, Yemeni, **Abdel-Ghaffar *et al.* (2015)** 33.3% hemiurid digenean parasite *Lecithochirium priacanthi* from moontail bullseye *Priacanthus hamrur* and **Eissa *et al.* (2017)** 35% in *Dicentrarchus labrax.* Moreover, it was higher than that obtained by **Youssef and Derwa (2005)** 28.36% in Sardinella sp., **Ekiaby (2009)** 26.56% in *Pagrus pagrus*, **Abdel-Mawla & El-Ekiaby (2012)** 26% in Seabass fish *Morone labrax* and **Ahmed (2017)** 9% in *Dicentrarchus labrax* & 25% in *Dicentrarchus punctatus*. Meanwhile, lower than that recorded by **Akmirza (2013**) *Lecithochirium fusiforme* 78.6% in *Conger conger* & 66.7% in *Muraena Helena* and **Chero *et al.* (2017)** 96.49% *Aponurus laguncula* in *Parapsettus panamensis* from the coastal zone of Puerto Pizarro.

Moreover, the prevalence of digenetic trematodes in *Scombermorus commerson* and *Siganus rivulatus* were 30% and 32% respectively. This result coincided to that obtained by **El-Labadi *et al.* (2006)** 30% in *Cheilinus abudjubbe*, **Morsy *et al.* (2011)** 32.8% in *Pagrus pagrus* fish from red Sea, but higher than that obtained by **Youssef and Derwa (2005)** 2.25% in Siganus sp., **El-Labadi *et al.* (2006)** 18.7% *Hexangium sigani* in *Siganus rivulatus* from the Gulf of Aqaba, **Hassanine (2007)** 20% in *Scarus ghobban*, **El-Ekiaby (2009)** 10.34% in *Scomberomorus commerson,* **Al-Zubaidy (2010)** 14.3 % in *Carangoides bajad* from the Red Sea, **Madhavi & Lakshmi (2011)** 16.8% from Indian mackerel *Rastrelliger kanagurta*, **Abdel-Mawla & Abo-Esa (2011)** 4.6% *Neonotoprus trachuri* from *Siganus rivulatus* and **Al-Hasawi (2019)** 17.19% *Gyliauchen volubilis* from *Siganus rivulatus* in the Red Sea. Meanwhile, differs from that recorded by **El-Labadi *et al.* (2006)** 50% from *Variola louti*, **Hassanine (2007)** 50% from *Crenimugil crenilabis,* **El-Ekiaby (2009)** 80% from Atherina sp. and **Boussellaa *et al.* (2016**) 42.25% of o Lecithochirium sp. from red-eye round herring *Etrumeus golanii***.**

The variation in prevalence and intensity vary from site to another, depending on fish species, availability of intermediate hosts, difference in physico-chemical properties of environments, season at which samples were collected. Additionally, region of catch and type of food found together with behavior of fish during its life. **El-Labadi *et al.* (2006), Al-Zubaidy (2010, 2011), Boussellaa *et al.* (2016**), **Ahmed (2017) and Eissa *et al.* (2017).**

In *Saurida undosquamis, and Scombermorus commerson* infested with *Aponurus laguncula ,Lecithocladium angustiovum ,Lecithochirium fusiforme* and *Parantorchis chaetodontis* there were mechanical destruction of the intestinal villi with sloughing of epithelial cells in lumen, necrosis and degeneration of the intestinal villi. In *Siganus rivulatus* infested with *Gyliauchen papillatus* there were hyperplasia of the intestinal villi along with diffuse mucinous degeneration of intestinal epithelium. **(Plate 6: A, C and E)**.

The liver of some infested fishes showed diffuse vacuolar degeneration of hepatic cells along with congestion of central veins and necrotic changes of some hepatocytes. **(Plate 6: B, D & F)**. This result coincided to that obtained by **El-Lamie (2007), Ahmed (2017) and Eissa *et al.* (2017)** who found that the intestine affected with digenetic trematodes showed severe congestion of the submucosal blood vessels, mucinous degeneration and focal epithelial desquamation in epithelial lining.

Table (1). The prevalence of digenetic trematodes among some Red Sea fishes

Fish species	Common names	N. of exam. fish	N. of inf. Fish	%	Parasitic isolate	Site of infest.
Saurida undosquamis (**Makarona**)	Brushtooth lizardfish	50	17	34	- *Aponurus laguncula* - *Lecithocladium angustiovum* *Lecithochirium fusiforme*	- stomach & intestine - intestine
Scombermorus commerson (**Derak**)	narrow-barred spanish mackerel	40	12	30	- *Parantorchis chaetodontis*	- intestine
Siganus rivulatus (**Sigana**)	Rabbitfish or Marbled spinefoot	50	16	32	- *Gyliauchen papillatus*	- intestine
Total		140	45	96		

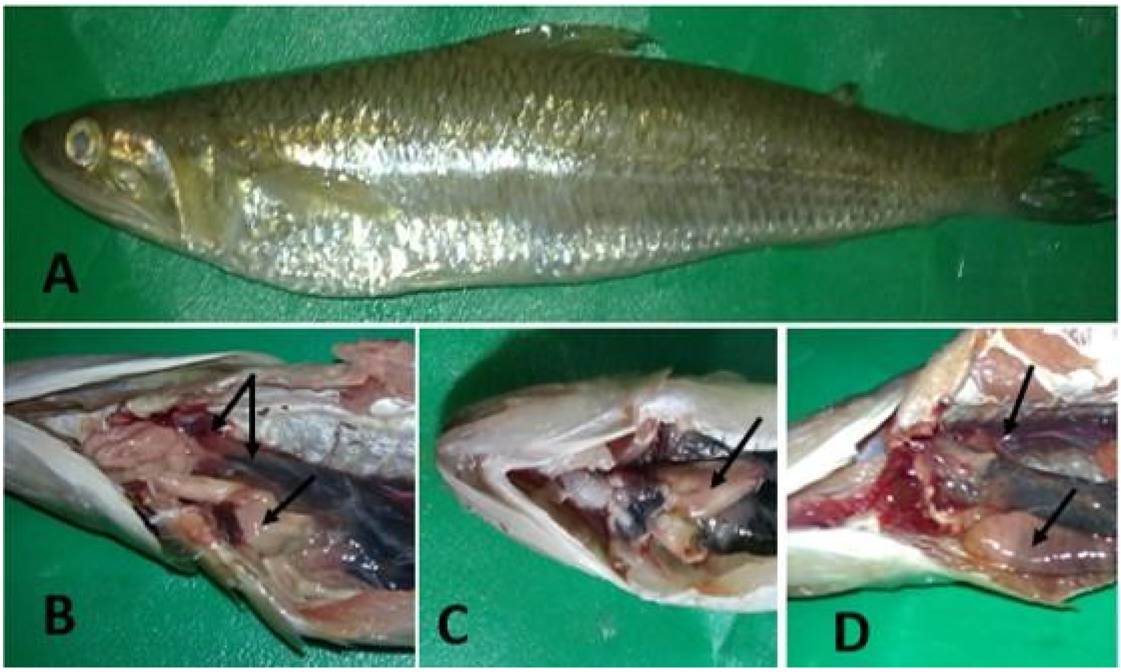

Plate (1): A: *Saurida undosquamis* fish infested with digenea showing slight abdominal distension.
B: the intestine was empty, paled organs with hemorrhage.
C: paleness in the liver of infested fish.
D: Slight bulging of the stomach, and hemorrhage on the mucous membrane with watery food.

Plate (2). The infested *Scombermorus commerson* showing: **A:** slight emaciation
B: congestion in the internal organs and hemorrhagic liver.
C: the intestine was pale, enlarged with inflammation and the Liver was appeared anemic.

Plate (3). A: The infested *Siganus rivulatus* showing dull appearance
B: Presence of congestion, petechial hemorrhage, darken edges of liver and paleness intestine.

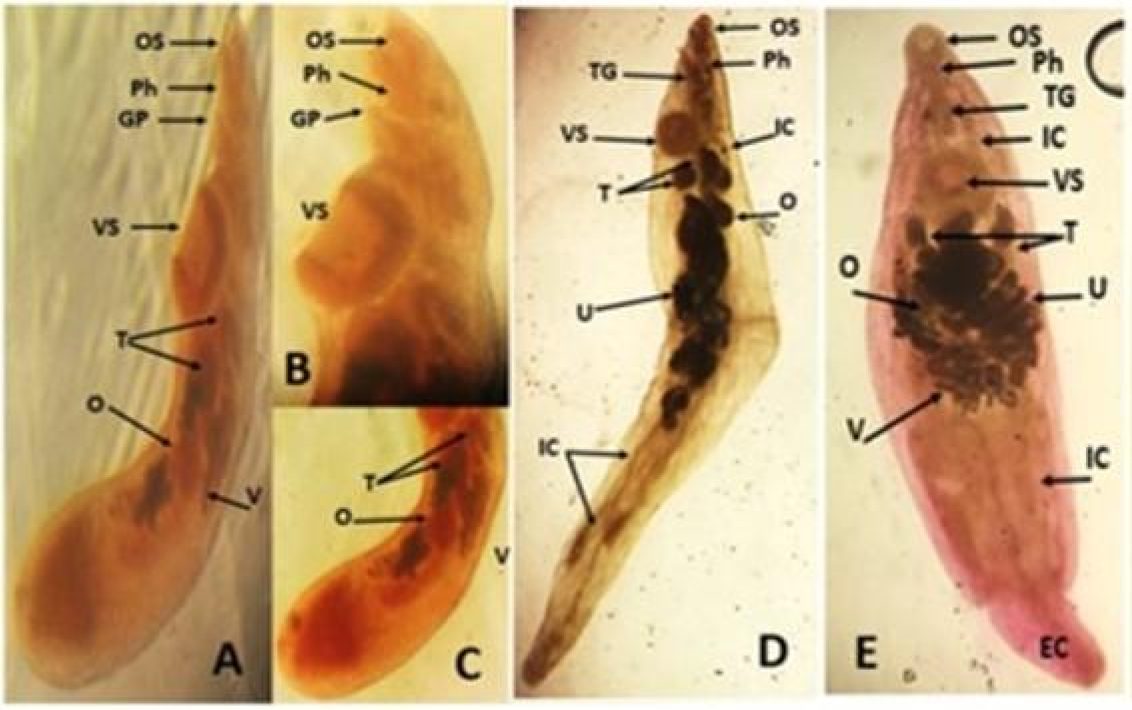

Plate (4). Digenea isolated from *Saurida undosquamis* **A:** *Aponurus laguncula*
B: Anterior part **C:** Posterior part **D:** *Lecithocladium angustiovum* **E:** *Lecithochirium fusiforme***.** OS: Oral sucker, Ph: Pharynx, Vs: Ventral sucker, U: uterus, V: Vitellaria, O: Ovary, T: testes TG:Terminal genitalia GP: genital pore IC: intestinal caeca, EC: evaginated ecsoma

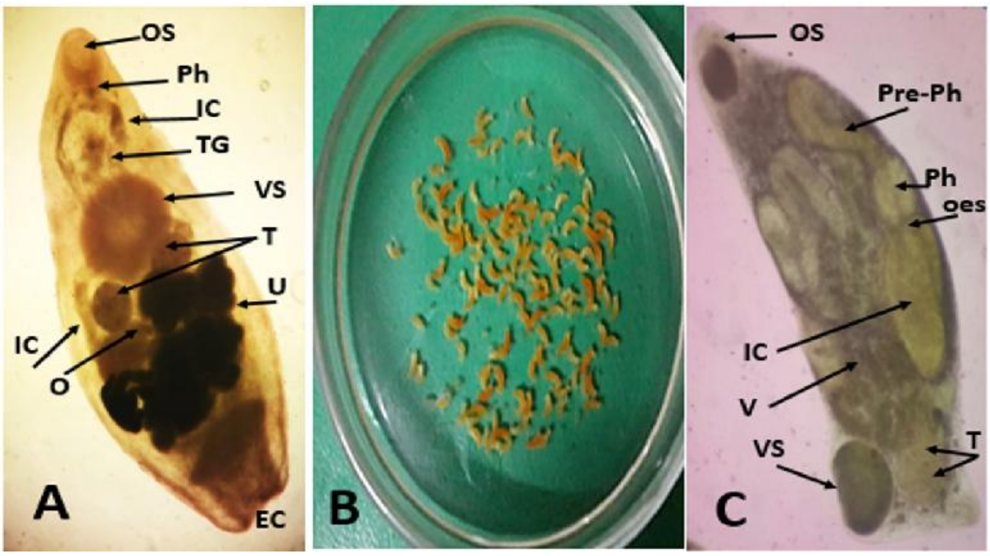

Plate (5). A: *Parantorchis chaetodontis* isolated from *Scombermorus commerson* **B:** digenetic trematodes isolated from one infested fish of *Siganus rivulatus* **C:** *Gyliauchen papillatus* isolated from *Siganus rivulatus.*

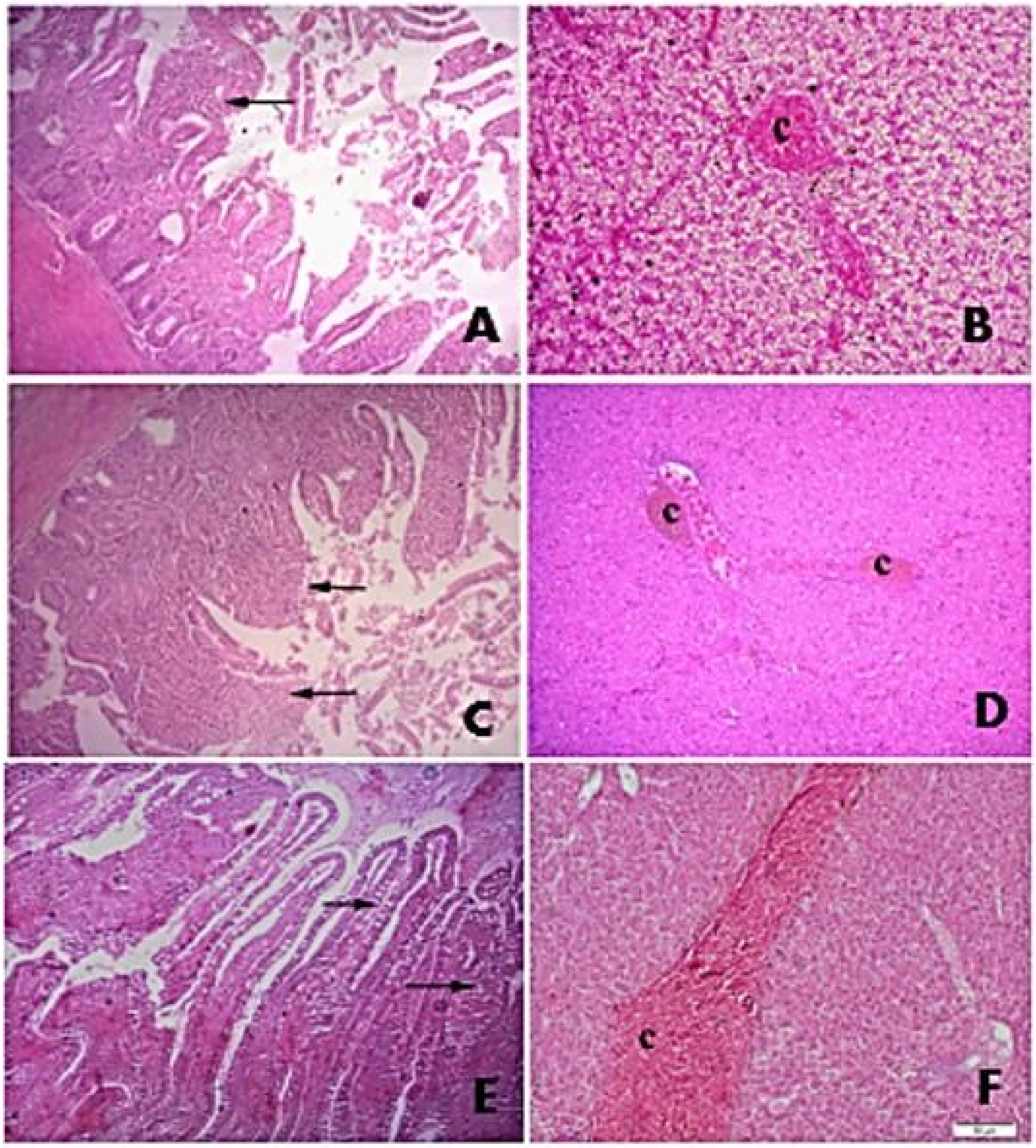

Plate (6). *Saurida undosquamis*, **A:** The intestine showed mechanical destruction of the intestinal villi (arrow) with sloughing of epithelial cells in lumen. H&E. X 200. **B:** liver showed diffuse vacuolar degeneration of hepatic cells along with congestion of central veins (C). H&E. X 200. *Scombermorus commerson*, **C:** necrosis and degeneration of the intestinal villi (arrows) with sloughing of epithelial cells in lumen. H&E. X 200. **D:** multiple congestion of central veins (C) and necrotic changes of some hepatocytes. H&E. X 200. *Siganus rivulatus*, **E:** intestine showing hyperplasia of the intestinal villi along with diffuse mucinous degeneration of intestinal epithelium (arrows). H&E. X 200. **F:** liver showing severe congestion of central veins (C) and degeneration of some hepatocytes. H&E. X 200.

Acknowledgments

We are sincerely thankful to Prof. **Dr. Amina A. Dessouki,** Dept. of Pathology, Fac. of Vet. Med., Suez Canal Univ. for her helpful comments and financial support in histo pathpological examinations during this work.

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