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Fine tegumental structures of the bothriocephalidean cestode, *Oncodiscus sauridae*, an intestinal parasite of the lizardfish *Saurida undosquamis* in Suez Gulf, Egypt.

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ABSTRACT

The present study showed that some lizardfishes collected from the Suez Gulf were infected with the intestinal cestode *Oncodiscus sauridae*. Ultrastructural examinations of *O. sauridae* mature proglottids revealed ten characteristic types of microtriches dressing the external surface of tegument (acicular, papilliform, spiniform, capiform, digitiform, columnar, lingual, tusk- shaped, vial- shaped and thorn-shaped).The syntegument is stacked on a thin basal lamina and inhabited with light membrane-bounded vesicles, dense bodies lacking a limiting membrane, ovoid mitochondria and convoluted secretory ducts ended with rounded reservoirs. Delicate cytoplasmic bridges and thin fibrous layer anchored the syntegument with underlying perikarya. The muscular network was arranged down syntegument in four (circular, longitudinal, ventral and diagonal) distinct orientations. Flame cells were connected with internal cytoplasmic ribs, their luminal cilia (about 100) were confirmed by many elongated rootlets and their excretory ducts were lined with enormous microvilli. Diverse mesenchymal cells (myocytons, tegumental, perikaryal, glandular and calcareous) embedded in the parenchymal were precisely described.

INTRODUCTION

The brushtooth lizardfish was invading the Mediterranean Sea from the West Pacific through Suez Canal **(Ben-Tuvia, 1966)**. The large scale saury is considered as one of the most prosperous colonizers distributed until the Aegean Sea **(Bilecenoğlu *et al.*, 2002; Mahmoud *et al.*, 2014)**. They are predatory benthic fishes feeding on smaller fishes and invertebrates **(Streftaris *et al.*, 2005)**. Lizardfishes are sold extensively in fish markets at Egypt owing to their preferable taste for millions of poor peoples. Few parasitological studies have been executed on this economically important fish at Egypt. The incidence of infection with the trematode *Paraplerurus sauridae* inside *S. undosquamis* occurred during February in India **(Sathyanarayana, 1981)**. Eleven different larval species were isolated from lizardfishes at Kuwait **(Petter and Sey, 1997)**. Heavy infections by the microsporidian cysts of *Glugea* sp. were discovered within the body cavity and viscera of lizardfishes collected from Arabian Gulf **(Adbel-Baki *et al.*,**

2009; Peyghan *et al.*, 2009; Al-Quraishy *et al*., 2012). A newly reported trematode *Sclerodistomum aegyptiaca* was isolated from lizardfishes collected from the Suez Gulf **(Taha and Ramadan, 2017)**. Two monogenean gill parasites, *Diclidophora merlangi* and *Loxuroides pricei* were recorded in lizardfishes of the Red Sea **(Morsy *et al.*, 2018)**. The ectoparasitic isopod *Gnathia* sp. was discovered on lizardfish collected from the Syrian coasts **(Hassan *et al*., 2018)**.
The genus *Oncodiscus* was revised by **Khalil and Abu-Hakima, (1985)** in lizardfishes collected from Kuwait Bay and Australian waters. *O. sauridae* was recorded firstly within lizardfishes collected from the Indo-Pacific **(Kuchta *et al*., 1997)**. Order Bothriocephalidea includes mainly intestinal parasites of teleost fish and has four families **(Kuchta *et al.*, 2008)**. Four species were recorded belonging to the genus *Oncodiscus*, namely; *O. fimbriatus*, *O. waltairensis* and *O. maharashtrae* in addition to *O. sauridae* **(Jadhav and Shinde, 1981)**.Spermatogenesis and ultrastructure of the sperms of *O. sauridae* from the lizardfish have been investigated **(Škoípvá *et al*., 2011)**. Studying the flatworm's teguments have been attracted the attention of helminthologists in the last few decades and Investigating microtriches types has a taxonomic significance **(Radwana *et al.*, 2014)**. No previous ultrastructural studies have been carried out on *O. sauridae* at Egypt. The present study aimed to research the fine cellular constructions of the body wall of this intestinal cestode infecting lizardfishes collected from Suez Gulf, Egypt. The present ultrastructural study may supply useful information for recognizing the biology of this bothriocephalidean cestode.

MATERIALS AND METHODS

Fresh Lizardfishes were obtained from local fishermen at Suez Gulf during 2019. Fishes were transferred and dissected in the laboratory. Living *O. sauridae* tapeworms were handled carefully from fish intestines and immediately rinsed in saline solution (0.9% NaCl). Mature proglottids were separated and fixed with 2.5% glutaraldehyde in 0.1 M cacodylate buffer at pH 7.4 for 2 days. They were washed overnight in 0.1 M sodium cacodylate buffer, post fixed in cold (4°C) 2% osmium tetra oxide in the same buffer for 1 h, dehydrated in graded series of ethanol and embedded in Epon resin. Ultrathin sections (60-90 nm in thickness) were mounted on copper grids and stained with uranyl acetate and lead citrate **(Reynolds, 1963)**. Grids were examined in JEOL 100 CX TEM at the Electron Microscopy Unit, Faculty of Agriculture, El-Mansoura University, Egypt.

RESULTS

1- Ultrastructure of the distal cytoplasm (syntegument)

1.1. Microtriches

The external surface of syntegument dressing the mature proglottids of *O. sauridae* is wrapped with two different kinds of hair-like microtriches which are classified into:-

A- Filitriches: two main types of filamentous microtriches devoid of terminal spines were detected:-

- **Acicular** or pin-shaped filitriches: have tubular and straight shafts (0.62 µm l – 0.12 µm w) composed of an electron-dense cortex and electron-lucent medulla (Figs. 1, 2, 3).

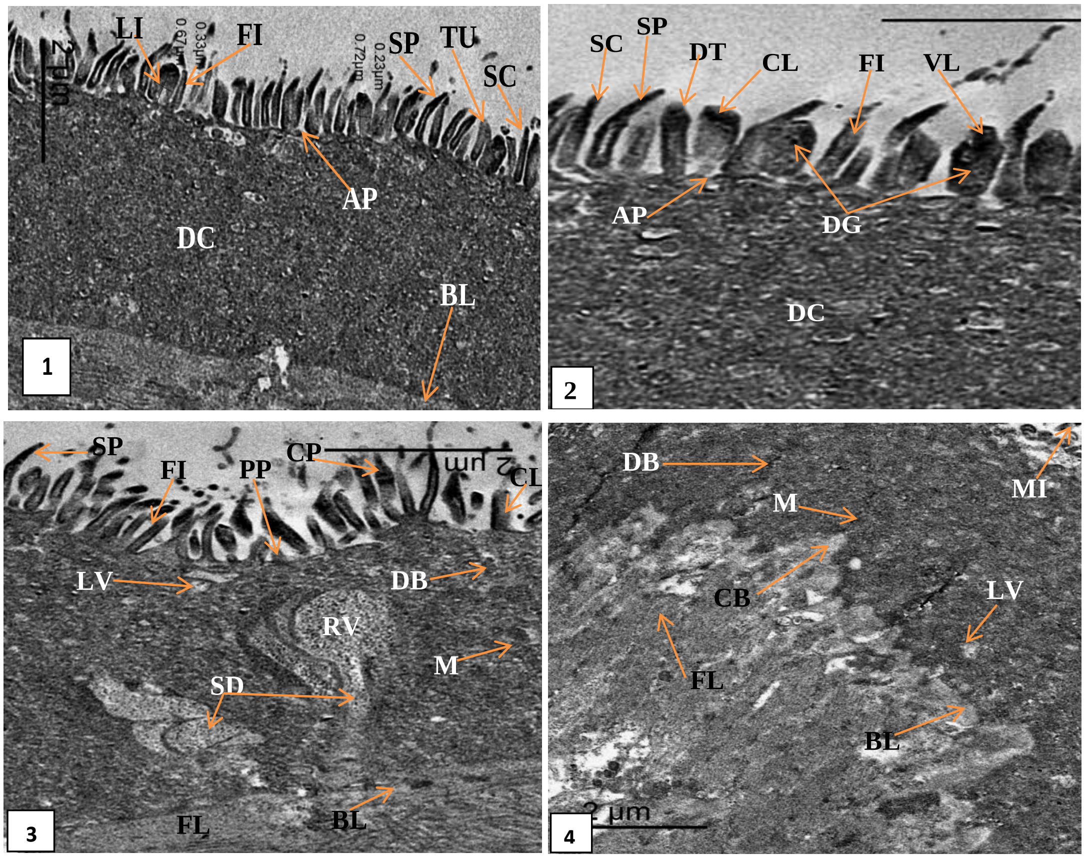
- **Papilliform** or nipple- shaped filitriches**:** minute papillae represented the shortest pattern of microtriches (0.09 µm l – 0.07 µm w).They are characterized by lightly stained shafts and medullae (Fig. 3).

***B- Spinitriches*:** eight characteristic types of spinitriches were recorded comprising the greatest degrees of morphological divergences as follows:-

- **Spiniform** or blade- shaped spinitriches: possess barb-like appearance (0.65 µml - 0.15 µml w) containing curved shafts and sharply pointed electron–dense spines directed towards the posterior end of the worm .Their shafts composed of electron-dense cortex and lucent medulla (Figs. 1,2,3).
- **Lingulate** or tongue- shaped spinitriches**:** own elongated lightly stained shafts (0.67 µm l - 0.33 µm w) and short electron-dense rounded spines (Fig. 1).
- **Tusk- shaped** or canine-shaped **spinitriches**: have leaf-shaped convex shafts **(**0.63 µml – 0.32 µmw) which tapered distally forming small curved and pointed spines (Figs. 1, 3).
- **Vial-shaped** or bottle-shaped spinitriches: possess elongated dense shafts (0.72 µml – 0.24 µmw) containing many electron-lucent vesicles comprising dark granules and covered with electron-dense flattened caps (Figs. 1, 2).
- **Digitiform** or finger- shaped spinitriches: with long tubular shaft (0.61 µm l – 0.35 µmw) composed of an electron-dense cortex and electron-lucent medulla. Shafts tips are wrapped with rounded and densely stained spines that resemble nails of human fingers (Fig. 2).
- **Columnar** or pillar- shaped spinitriches: reign rectangular shafts (0.68 µm l – 0.36 µm w) containing densely stained granules within the lucent medullae. Terminal flattened cap covered the upper surface of their shafts (Figs. 2, 3).
- **Scolopate** or thorn-shaped spinitriches: possess slightly convex electron-lucent shafts (0.65 µml – 0.21 µmw) that tapered gradually forming a sharp, electron-dense and elongated distal spine (Fig. 2).
- **Capiform** or cone-shaped spinitriches: have shafts with straight sides (0.76 µml – 0.33 µmw) that tapered gradually throughout their lengths forming a conical, darkly stained and pointed spines. Electron-dense cross striations situated at the junction between shafts and their caps (Fig. 3).

1.2. The distal cytoplasmic matrix

The matrix of distal cytoplasm (2.15 µm thick) was inhabited by variable inclusions and stained densely with uranyl acetate. It was lined externally with a delicate apical plasma membrane and rested basely on a thin connective tissue layer called basal lamina. The matrix included numerous circular to oval light vesicles limited by a distinct unit membrane and dense globular bodies lacking a limiting membrane (Fig. 3). Some ovoid mitochondria containing few cristae and many convoluted secretory ducts with large spherical reservoirs were observed. Under the basal lamina there was a well-developed fibrous connective tissue composed of parallel fibers and electron dense granules. Cytoplasmic bridges and the fibrous layer bind the distal cytoplasm with underlying fibrous parenchyma (Fig. 4).



Figs (1-4): Electron micrographs showing the tegumental covering the mature proglottid of *O. sauridae* (Scale bar 2 µm)**. (1):** The distal cytoplasm covered with different types of hair-like microtriches **(2):** Syntegument with different apical microtriches and underlying basal lamina. **(3):** Fine structure of syntegument with characteristic vesicles and excretory ducts. **(4):** Cytoplasmic bridges connecting distal cytoplasm with underlying fibrous connective tissue layer.

AP: Apical plasma membrane; BL: Basal lamina; CB ;Cytoplasmic bridges; CL: columnar spinitriches; CP: Capiform spinitriches; DB: Dense bodies; DC: Distal cytoplasm; DG: Dark granules; DM; Diagonal muscle; DT : Digitiform spinitriches; Fi: Acicular filitriches; Fl: Fibrous connective tissue layer ; FIM: Fibrous intercellular matrix; LI: lingual-shaped spinitriches ; LM: Longitudinal muscle fibers; LV: Light vesicles; M : Mitochondria ; MI: Microtriches; PP: Papilliform filitriches; RV: Reservoir; SC: Scolopate spinitriches ; SP :Spiniform spinitriches ; TU : Tusk- shaped spinitriches; VL: Vial- shaped spinitriches.

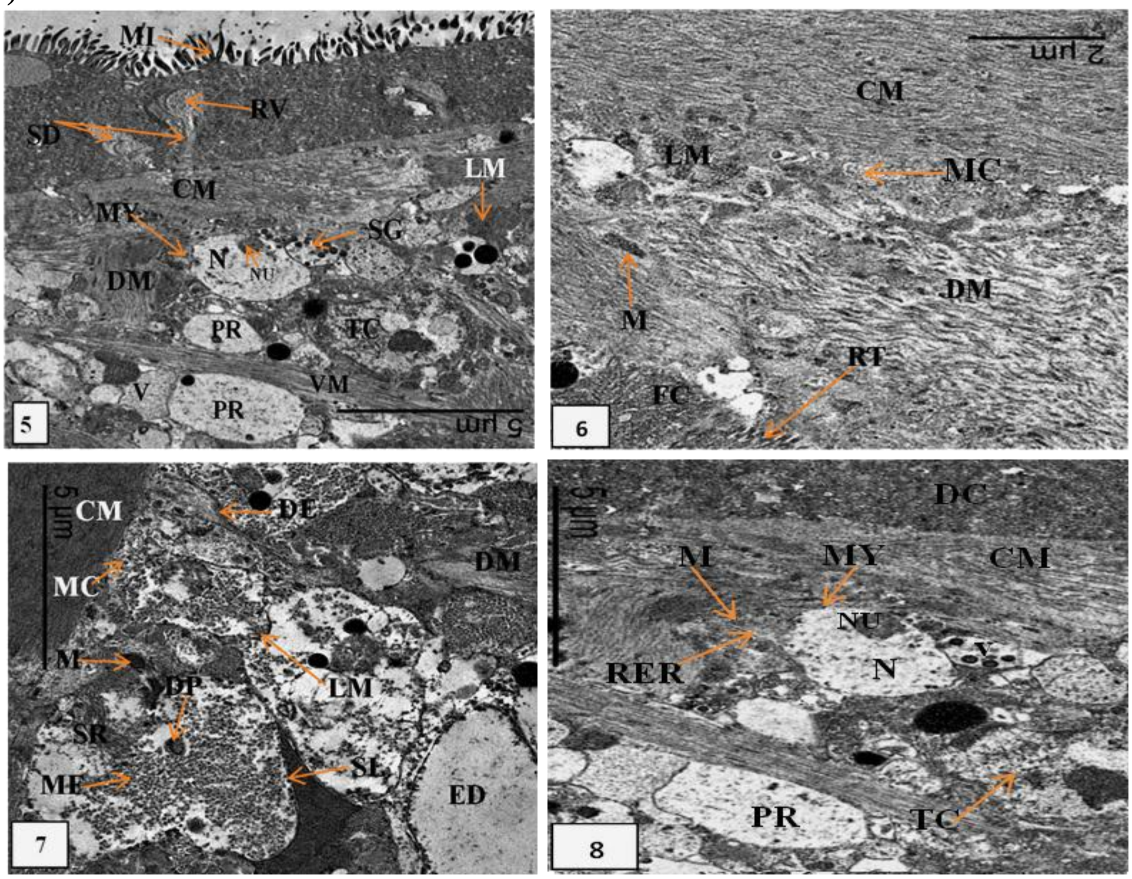
2. Ultrastructure of cytotegument

2.1. Musculoparenchyma

The muscular network was arranged along and down the syntegument in four distinct orientations; an outer circular layer, an inner longitudinal layer, deep ventral muscles and diagonal muscles in between (Fig. 5). Some microtubules were inserted between longitudinal muscle fibres (Fig. 6). Circular and longitudinal muscle layer contains many myofibers each was enveloped by a thin layer of sarcolemma interconnected by many desmosomes. The circular muscle myofibers comprised few mitochondria with few cisternae, aggregations of peripheral microtubules and cisternae of smooth sarcoplasmic reticulum. Irregular darkly stained patches were observed between myofibrils (Fig. 7).

2.2.Myocytons

Myocytons were considered as one kind of parenchymal cells located between muscular layers. The nucleus was enveloped by a doubled nuclear membrane comprising little chromatin material and a large nucleolus. The outer surface of the nuclear envelope was studded with enormous ribosomes. The perinuclear cytoplasm contained scattered densely stained granules, numerous free ribosomes and will-developed rough endoplasmic reticulum. Few ovoid mitochondria were observed scattering throughout the cytoplasm in addition to many light vesicles containing dark secretory granules (Figs. 5, 8).



Figs. 5- 8: Electron micrographs showing the muscular network and myocytons of the mature proglottid of O. sauridae. **(5)**: Orientations of the circular, longitudinal, diagonal and ventral muscle layers (Scale bar 5 µm).**(6):** higher magnification of the area of interconnection between circular, longitudinal and diagonal muscle bundles (Scale bar 2 µm).**(7):** Myofilaments of longitudinal muscle bundles (Scale bar 5 µm). **(8):** Fine structure of magnified myocyton inserted between muscle bundles (Scale bar 5 µm).

CM: Circular muscles; DC: Distal cytoplasm ; DE: Desmosomes ; DM : Diagonal muscles ; DP: Dense patches ;ED: Excretory duct; FC: Flame cell ; LM: Longitudinal muscles ; M: Mitochondria; MC: Microtubules; MF: Myofibers; MY: Myocyton ;N: Nucleus; NU: Nucleolus ; PR: Perikaryal cell ; RER: Rough endoplasmic reticulum ; RT :Striated rootlets; RV: Reservoir ; SD: Secretory duct ; SG: Secretory granules ; SL: Sarcolemma; SR: Smooth sarcoplasmic reticulum; TC: Tegumental cell; V: Vesicle; VM: Ventral muscles.

2.3. Excretory flame cell

The flame cells of *O. sauridae* were large bodies concentrated between muscle layers and characterized by their branched cytoplasmic processes (about 80). The nucleus was oval and comprised several heterochromatin patches and large nucleolus (Fig. 9). The cytoplasm was scanty and contained few oval mitochondria, free ribosomes and minute vesicles. A tuft of cilia (bout 100 cilium) occupying the lumen of flame cell was confirmed in the cytoplasm by elongated striated rootlets. Flame cells were covered with an outer thin fibrous sheath and connected to each other by internal cytoplasmic ribs (Fig. 10). The wall of excretory duct was filled with a thin layer of granular cytoplasm containing many mitochondria, glycogen particles and concentric rough endoplasmic reticulum. Numerous vesicles included electron-dense materials were noted and the lumen of the duct was provided with numerous microvilli (Fig. 11).

2.4. Tegumental cells

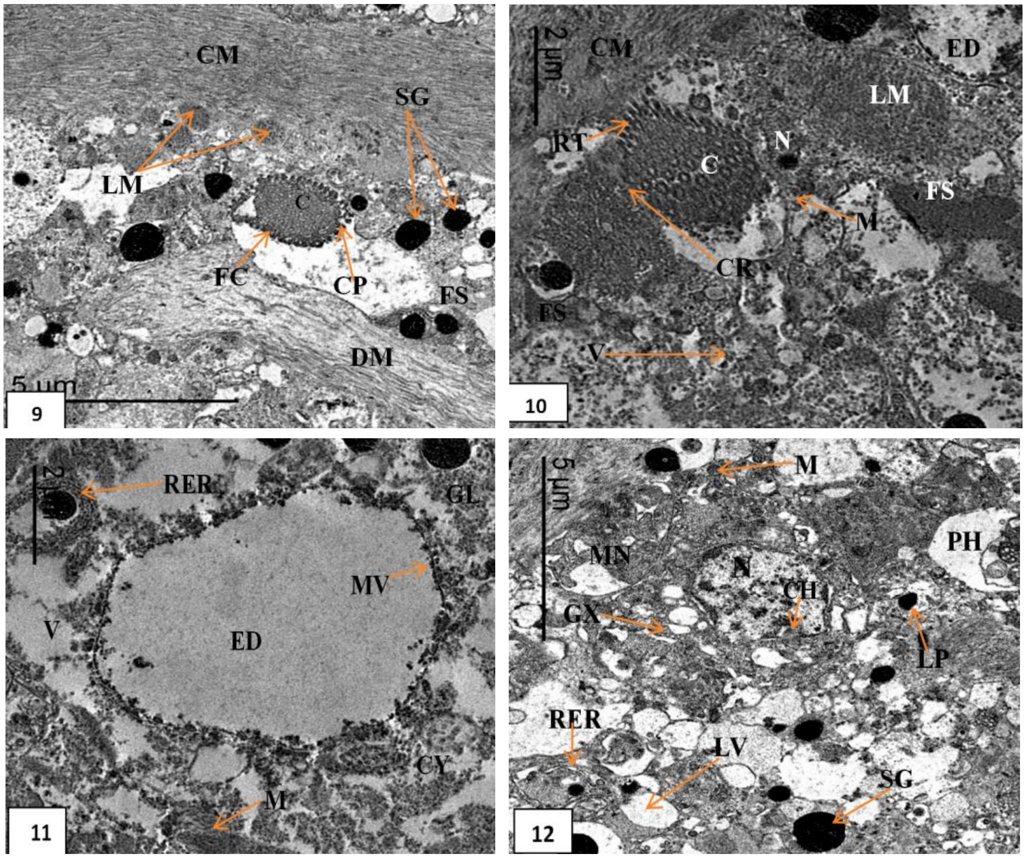
The tegumental cells have a polygonal shape with multiple cytoplasmic extensions and densely granulated cytoplasm. The nucleus of tegumental cell was large, irregular and centrally located. The nucleoplasm was surrounded by a double layered nuclear envelope. The nucleus comprised a granulated nucleolus and electron dense chromatin patches. The electron-dense perinuclear cytoplasm enclosed aggregations of mitochondria, free ribosomes and well-developed Golgi apparatus. The rough endoplasmic reticulum formed of many narrow cisternae. Various cytoplasmic inclusions were observed such as glycogen granules, lipid globules and multiple electron-lucid vesicles packing their cytoplasmic protrusions (Fig. 12).

2.5. Perikaryal cells

Perikaryal cell is characterized by a large ovoid centrally located nucleus. The nucleus contained electron lucent nucleoplasm, peripheral small dark nucleolus and fine electron-lucent chromatin patches. The cytoplasm was inhibited with excessive granular endoplasmic reticulum and uniformly distributed free ribosomes. Few large sized oval mitochondria were found around the nucleus and the smooth endoplasmic reticulum was represented by small vesicles or narrow elongated sacs. Golgi complex was concentrated near the nucleus and consisted of several small vesicles (Fig. 13).

2.6. Glandular cells

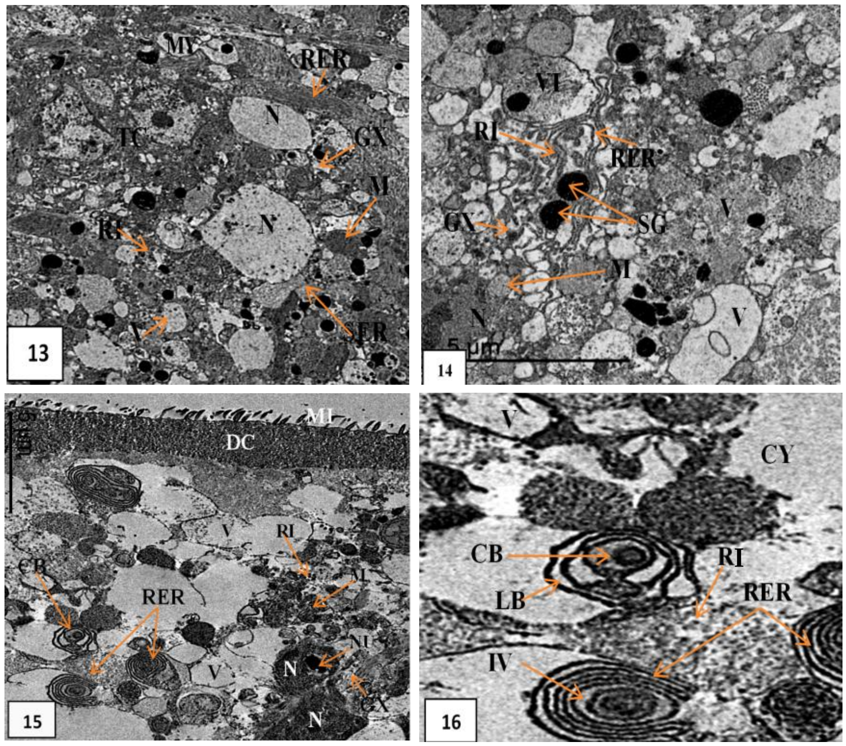
A large cell has no obvious cell boundaries and its granular cytoplasm was loaded with free ribosomes and glycogen particles. A large oval nucleus was found comprising an electron-dense nucleoplasm and elongated dark nucleolus. The cytoplasm comprised a well- developed granular endoplasmic reticulum formed of elongated sacs. The cytoplasm was crowded with many rounded mitochondria, free ribosomes and Golgi complex consisted of many small vesicles. Multiple secretory granules of different sizes were aggregated within enormous electron-lucent vesicles of various shapes and sizes (Fig. 14). The ducts of glandular cells were extended along the basal lamina and ended inside syntegument with vertical convoluted ducts that ended with rounded reservoirs containing fine secretory granules (Figs. 3, 5).



Figs. 9-12: Electron micrographs showing flame cells, excretory duct and tegumental cells. **(9):** Sub muscular layer containing flame cell provided with numerous cytoplasmic processes (Scale bar 5 µm).**(10):** Two adjacent flame cells connected with cytoplasmic ribs(Scale bar 2 µm). **(11):** Cytoplasmic inclusions of the excretory duct (Scale bar 2 µm). **(12):** Tegumental cell and neighboring multipolar neuron (Scale bar 5 µm).
C: Cilia; CH: chromatin material ; CM : Circular muscle layers; CP: Cytoplasmic processes ; CR: Cytoplasmic ribs; CY: Cytoplasm; DM: Diagonal muscles ; ED: Excretory duct ; FC: Flame cell; FS: Fibrous sheath; GX: Golgi complex ; LM: Longitudinal muscles; LP: Lipid globule ; LV: Lucent vacuoles; M: Mitochondria ; MN: Multipolar neuron ; MV: Microvilli ; N: Nucleus; RER: Rough endoplasmic reticulum; SG: Secretory granules; RT : Rootlets ; V: Vesicles.

2.7. Calcareous cells

The calcareous cell is manifested by the presence of an enlarged oval nucleus comprising electron- dense granular nucleoplasm, large irregular nucleolus and condensed chromatin material. The thin cytoplasm was vacuolated and containing multiple lamellar bodies. The cell cytoplasm was characterized by the presence of concentrically coiled cisternae (onion shaped) of rough endoplasmic reticulum. In the central cytoplasmic cavity, free ribosomes, oval mitochondria, Golgi complex and many electron-lucent vacuoles were observed (Fig. 15). As the calcareous body enlarged, it became flattened and formed of successive concentric lamellae. Calcareous bodies were formed on mineralized pulps in intercellular vacuoles (Fig. 16).



Figs. 13-16: Electron micrographs showing fine structures of Perikaryal, glandular and calcareous cells confirmed in the parenchyma (Scale bar 5 µm). **(13):** Two Perikaryal cells with characteristic nuclei beside tegumental cell. **(14):** Glandular cells cytoplasm contained a large nucleus, elongated cisternae of rough endoplasmic reticulum and secretory vesicles **(15):** The calcareous cell with characteristic concentric rough endoplasmic and the calcareous body. **(16):** Higher magnification of the lamellar body formed within intercellular vacuole of the calcareous cell.

CB: calcareous body ; CY: Cytoplasm; DC: Distal cytoplasm; GX: Golgi complexes ; IV : Circular intercellular vacuole; LB: Lamellar body; LP: lipid droplets ; M: mitochondria ; MI: Microtriches ; MY: Myocyton ; N :nucleus; NU :nucleolus, PR :perikaryal cell ; RER: rough endoplasmic reticulum ; RER: Rough endoplasmic reticulum; RI : Ribosomes ; SER: Smooth endoplasmic reticulum SG: Secretory granules ;TC: tegumental cell; V :vacuoles; VI : Electron-lucid vesicles .

DISCUSSION

Integumentary tissues of cestodes performed multiple functions as protection, supportation, secretion, excretion, and osmoregulation **(Smyth and Halton, 1983)**. Cestode tegument resembles an inverted midgut of higher animals **(Smyth and McManus, 1989)**. The tegument of cestodes has a syncytial structure which may provide rapid growth rates and facilitates metabolite distribution **(Korneva, 2013)**. Tegumental microtriches are varied in shapes and sizes in cestodes of related or different taxonomic relationships **(Poddubnaya *et al*., 2003)**. Ten characteristic types of (acicular filitriches, papilliform, spiniform, capiform, digitiform, columnar, lingual, tusk- shaped, vial- shaped and thorn-shaped) microtriches were observed dressing the outer surface of distal cytoplasm. This finding disagree with **Ahmed *et al.* (2019)** who observed only three types of microtriches covering the mature proglottids of *Polyonchobothrium clarias* cestode infecting *Clarias gariepinus* in Egypt. The tegument *Nematotaenia kashmirensis*, a cestode infecting the toad *Bufo regularis* in Egypt bears three types only of microtriches, namely: filiform, spiniform and digitiform **(El Kabbany, 2009)**. Filiform microtriches may participate in digestion while spiniform may be fixative type **(Poddubnaya *et al*., 2007)**. The darkly stained granules included within electron- lucent minute vesicles discovered inside vial and columnar microtriches may provide their roles in absorption and or digestion of nutrients. The glycocalyx on the tegument may protect the worm against the host's enzymatic activity **(Oaks and Holy, 1994)**. The present study showed that syntegument of *O. sauridae* stained densely with uranyl acetate and lead citrate and this may be due to high contents of glycoproteins. The syntegument of *Schistosoma* stained intensively carbohydrates and protein stains **(Wheater and Wilson, 1976)**. This study illustrated the presence of many syntegument inclusions in the form of numerous membrane bounded light vesicles and dense bodies lacking a limiting membrane and these vesicles have been considered as secretory vesicles **(Oaks and Holy, 1994)**. Early studies suggested that the dark bodies manufacturing raw materials essential for microtriches formation in Caryophyllidea **(Richards and Arme 1982; Poddubnaya 1996)**. Autoradiographic studies indicated that tegumental vesicles of helminthic worms secrete the glycocalyx **(Hanna, 1980)**. The electron-dense glandular secretion may neutralize the immune effect of the host organism against the parasite **(Davydov, 1991)**. This was demonstrated by immunocytochemical studies in *Hymenolepis diminuta*, **(Holy *et al*., 1991)**.

The smooth muscle layers (musculoparenchyma) of cestodes constitute the main volume of parenchyma (Conn and Rocco, 1989).The present work declared that the muscular network of *O. sauridae* is arranged in circular, longitudinal, ventral and diagonal orientations. Similarly, scolex of *Cysticercus pisiformis* showed thick muscular layer arranged in vertical, oblique, circular and longitudinal muscle bundles **(Radwana *et al*., 2014)**.These findings disagree with **Tyler and Hooge, (2004)** who found that the body wall in turbellarian is formed of diagonal muscle fibers between circular and longitudinal fibers while ventral muscles are absent. Few mitochondria and sac-like cisternae of sarcoplasmic reticulum were noted. The sarcoplasmic reticulum may be concerned with transferring stimuli between myofibers **(Mac Rae, 1965)**. Cestode muscles extract energy required for contraction during anaerobic glycolysis and so they contain a few numbers of mitochondria **(Lumsden and Specian, 1980)**.

Parenchymal tissues of cestodes are composed of polymorphic cells that play vital roles in the formation of fibrous matrix, glycogen storage and transportation **(Gallagher and Threadgold 1967)**. They are important in protein and carbohydrate synthesis and lipid metabolism in cestodes **(Lumsden and Harrington, 1966)**. Myocytons are included as one type of parenchyma and may perform many functions other than locomotion such as ion regulation and glycogen storage **(Ross and Klebanoff, 1971)**. Myocytons may be secretory, storage or secretory/ storage **(Conn *et al*., 1984)**. In our study, numerous myocytons were observed between muscle bundles and are characterized by their electron-lucent nuclei and their cytoplasm contain many mitochondria, excessive RER and many secretory granules aggregated within vesicles suggesting that myocytons performed both secretory and storage functions. Most flatworms possess secretory/storage myocytons in which glycogen and lipids are stored within specific cytoplasmic regions (**Hildreth and Lumsden, 1983)**.

Protonephridial system of helminthes is concerned with reabsorption, excretion and osmoregulation **(Webster, 1972; Vinogradov *et al***., **1982)**. Flame cells are immune-modulator in the excretion of prostaglandins **(Kutyrev *et al*., 2017)**. The arrangement and numbers of axonemes of cilia in flame cells may be valuable in the phylogeny of flukes **(Rohde, 2001)**. Flame cells of *O. sauridae* are connected to each other by cytoplasmic ribs and their luminal tuft (about 100 cilia) was confirmed in the cytoplasm by striated rootlets. **El Kabbany, (2009)** reported that the number of cilia in flame cells of *Nematotaenia kashmirensis cestodes* was 54 cilium. In agreement with this study, flame cells are joined with excretory ducts by the interdigitation of ribs in the cytoplasm **(Parshad and Guraya, 1977)**. The beating of cilia withdraws wastes to the outside through epithelia of excretory ducts that furnish filtration of body fluids **(Lumsden and Hildreth, 1983)**. The excretory duct of *O. sauridae* is lined with enormous microvilli which may increase its absorptive surface area. Similarly, the inner wall of excretory duct of the tapeworm *Dibothriocephalus latus* is covered by microvilli **(Yamane *et al.*, 1982; Barčák *et al.*, 2019)**.

This study ensured the presence of Golgi complexes, free ribosomes, and granular endoplasmic reticulum in tegumental cells of *O. sauridae* that provided their role in protein synthesis **(Threadgold and Gallagher, 1966)**. Lipid droplets appeared inside tegumental cells and are common in parenchymal cells of Platyhelminthes **(Threadgold and Arme, 1974)**. Similarly, Investigations using autoradiography revealed that tegumental cells of *Hymenolepis diminuta* were the major sites of lipid metabolism **(King and Lumsden, 1969)**. Specific features of these cells include glycogen granules, smooth endoplasmic reticulum, numerous mitochondria and lipid droplets suggested their roles in glycogenesis and glycogenolysis **(Lumsden, 1966; Gallagher and Threadgold, 1967; Threadgold and Arme, 1974**).

The cytoplasm of Perikaryal cells included excessive amounts of rough endoplasmic reticulum, free ribosomes, smooth endoplasmic reticulum and Golgi complexes proving that these cells are believed to be involved in protein synthesis. The presence of proteins and glycogen in their cytoplasm is demonstrated histochemically **(Toner and Carr, 1971)**. The present ultrastructural study showed that the cytoplasm of the glandular cells included a well-developed granular endoplasmic reticulum, mitochondria, ribosomes and secretory granules and this may prove the suggestion of their role as an active site protein synthesis. Their secretory granules go through ducts toward the distal cytoplasm of the tegument **(Richards and Arme, 1981; Kuperman and Davydov, 1981)**. The terminal ends of their excretory ducts opened with rounded reservoirs similar to those reported in *Diphyllobothrium dendriticus*, *D. ditremus* and *D. latus* **(Öhman-James, 1973; Kuperman and Davydov, 1982)**. Calcareous cells are also characteristic of cestodes but their functions have not been demonstrated conclusively **(Smyth and McManus, 1989)**. The calcareous cells of *O. sauridae* were found to contain multiple lamellar bodies and concentrically coiled cisternae of rough endoplasmic reticulum. Calcareous bodies were formed on the basis of mineralization center. Calcareous corpuscles were found to yield Ca, Mg and P, so they may serve to buffer acids that enter their bodies from the outside **(Brand, *et al.*, 1960)**. Calcareous corpuscles provided a reserve food for the developing embryos, protection against gastric acid of the host, osmoregulation, fixation of metabolic wastes and egg pouch formation in cestodes **(Podesta and Mettrick, 1976)**. The discovery of serially arranged calcareous corpuscle masses in caryophyllid cestodes proved the unique nature of monozoic tapeworms **(Mackiewicz and Ehrenpris, 1980)**. Several protein components were reported to take part in corpuscles formulation and to possess protein-binding activities **(Park *et al.*, 2005)**. Further studies on the functions of these proteins are required.

CONCLUSION

Parasitological investigations in this study revealed that few lizardfishes collected from the Suez Gulf were infected with the intestinal cestode *O. sauridae*. Ultrastructural studies showed ten types of microtriches covering the syntegument of *O. sauridae* mature proglottids. The muscular network was arranged in four distinct orientations. The lumen of flame cell comprised approximately 100 cilia. Structurally different five cell types were embedded in the fibrous matrix. The present ultrastructural study may furnish useful notifications in realizing the fine cellular structures of this parasitic cestode. Further studies must be carried out for controlling this harmful parasite infecting the economically important lizardfishes at Suez Gulf.

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