Dept. of Parasitology,
Fac. Vet. Med., Alexandria Univ.,
Head of Dept. K.E. Ashmawy.

ELECTRON MICROSCOPIC STUDY ON THE TEGUMENT OF FASCIOLA GIGANTICA

(With 9 Figures)

By

FATMA HIEKAL

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دراسة التركيب الاليكتروني لجلد الدودة الكبدية
(الجيجانتكا)

فاطمة هيكل

يتركب جلد الدودة الكبدية من طبقة سطحية عديمة الأنوية متصلة بخلايا طلائية عميقة عن طريق امتداد أنبوبي . وقد تميزت الخلايا الجلدية الي نوعين نوع غامق ونوع فاتح وقد تميزت الخلايا الغامقة بوفرة المبتوكندريا وحبيبات إفرازية كثيفة محاطة بغشاء. أما الخلايا الفاتحة فقد تميزت بوجود عدد قليل من المبتوكندريا وأجسام مفرزة مفلطحة وقد أظهرت الطبقة السطحية هذين النوعين من الأجسام المفرزة .

SUMMARY

The tegument of Fasciola gigantica was composed of surface non-nucleated layer (syncytium) connected to deep tegument cells by tubular extensions. The tegumental cells were two types, dark cells and light cells. The dark cell was characterized by numerous mitochondria and dense membrane-bounded secretory granules, while the light cell was characterized by few mitochondria and flattened membrane-bounded secretory bodies. The surface syncytium showed both types of secretory bodies.

INTRODUCTION

The ultrastructure of the tegument of Fasciola hepatica was studied by BJORKMAN & THORSELL (1963); THREADGOLD (1963 & 1967), GALLAGHER & THREADGOLD (1967) and BENNETT & THREADGOLD (1973, 1975). It was composed of a syncytium, non-nucleated surface-layer joined by protoplasmic tubes to individual nucleated areas of cytoplasm (tegumental cells) which were embedded within the parenchyma.

THREADGOLD (1967) mentioned that the tegumental cells were of two types, type I characterized by presence of membrane-bounded dense secretory granules and type II cell characterized by presence of biconcave disk-like secretion bodies.

From the available literatures, no study was carried out on the tegument of Fasciola gigantica using transmission electron microscope. So the aim of this work

was to throw spot of light on the ultrastructure of the tegument of F.gigantica and to compone it with that of F.hepatica.

MATERIAL and METHODS

Fasciolo gigantica adult worms were collected from the bile ducts of cattle which had been slaughtered only a short while. The flukes were placed in fixative and thin strips were cut from their initial, middle and caudal thrids. The fixative was 4% buffered glutaraldehyde at PH 7.4 for 2 hours followed by 2 h. postomsication. The fixed samples were washed in 0.1 M sodium cacodylate containing 5% sucrose then processed through tannic acid, dehydrated in ascnding grades of ethanol and embedded in epon. Ultrathing sections were cut with a diamond knife and stained with uranyl acetate for 20 minutes, followed by lead citrate for 5 minutes.

RESULTS

The tegument of Fasciola gigantica is composed of outer non-nucleated layer (Syncytium) connected to deep tegumental cells by cytoplasmic tubular extension. The syncytium is covered by trilamillar plasma membrane with many finger-like or irregular evaginations which contain electron dense granular material similar to that of the rest of the syncytium (Fig. 1). Invaginations were also observed containing membraneous vacuoles and granular material. The syncytium has some mitochondria, few endoplasmic reticulum, vacuoles, dense secretory bodies and spines. It rests on a bsement membrane which showes long invaginations into the parenchyma. The tubular extensions is made up of plasma membrane with a thin layer of cytoplsm. These tubes contain many dense secretory bodies and granules (Fig. 2). The tegumental cells are lying below the peripheral musculature and they are dark and light cells.

The dark cells are found in groups 2 to 3 in each group. Each cell is flask-shaped and connected to the surface syncytium through tubular cytoplasmic extension (Fig. 3). The cytoplasm is dense and full-of mitochondria, more than one well developed golgi complex, rough endoplasmic reticulum and free ribosomes (Fig. 4). This cytoplasm is characterized by the presence of membrane bounded very dense secretory granules of variable sizes distributed allover the cytoplasm and extend through the tubular extensions into the surface syncytium. These secretory granules originate from the rough endoplasmic reticulum golgi complex (Fig. 5). The dark cell has a large nucleus with darkly stained prominant nucleolus.

The light tegumental cells are also flask shaped being found singly among groups of dark tegumental cells (Fig. 6). They were clearly differentiated from the latter cells by their less electron dense cytoplasm. They have many free ribosomes and few mitochondria usually located at the supranuclear region. Flattened disc-like secretory bodies can be seen (Fig. 7). These bodies are scattered randomly throughout the cells and may occur in very few numbers in the tubular extension which connect the cell to the surface syncytium. The nucleus is large and containes large prominent nucleolus.

Sometimes free ribosomes appear in the form of many polyribosomes and the cytoplasm showes large membrane bounded spherical secretory granules of variable sizes and in different stages of synthesis (Fig. 8). These granules contained densely packed granular material and many of them were observed in the tubular extensions and the intercellular spaces. Thee granules have a structure similar to that of the spines.

Each of the tegumental cells is in contact with at least one of the parenchymal cells, which is found individually between the groups of the former cells (Fig. 9). The parenchymal cell has relatively small darkly stained nucleus with clear ncleolus and long cytoplasmic processes (pseudopodia) of irregular shapes. The cytoplasm had fine granules and fibrils interspersed with clear areas or compact granular mass.

DISCUSSION

The present study showed that the cuticle of F.gigantica is a cellular tegument. This result coincides with the findings of BJORKMAN and THORSELL (1963); THREADGOLD (1963); THREADGOLD and GALLAGHER (1966); THREADGOLD (1967); GALLAGHER & THREADGOLD (1967) and BENNETT & THREADGOLD (1975) who were working on the tegument of F. hepatica.

The tegument was composed of non-nucleated surface layer (Syncytium) connected by cytoplasmic tubular extensions to deep tegumental cells located in the parenchyma. These cells were of two types, dark cells and light cells. THREADGOLD (1967) described similar findings in the tegument of F. hepatica and named these cells type I and type II cells respectively. The dark cell was characterized by its dense cytoplasm which was full-of mitochondria and contained many membrane-bounded very dense secretory granules. These granules were clearly observed in the surface syncytium in addition to few flattened disk-like secretory bodies of the light tegumental cells. THREADGOLD (1967) mentioned that neither type of secretion has been seen in process of release onto the apical surface, and were not acid mucopolysaccharides. He added that neither do these bodies appear to contribute to theformation of the spines. So, the presentdata confirm his opinion tht these bodies may have a protective function through their combination with other substances absorbed either selectively or because the fluke cannot prevent their entry.

From the above mentioned observations it appears that the tegument of F. gigantica serve as both secretory and a protective covering.

In the present work, the large spherical secretory granules which appeared inthe light cells and have closely packed granular material similar in its structure to that of the spines let me suggest that these granules are the forerunner of the spines thus the light cells are the site of synthesis of spine material. BENNETT and THREADGOLD (1975) mentioned that no study of adult trematodes has yet yielded any explanation of the origin or development of the spines. They added that the tegumental cells must be the origin after excluding the syncytial layer since it does

not contain either Golgi complex or ribosomes. They also suggested that spine material may be synthesized on polyribosomes but it did not appears in the cytoplasm because it is in a monomer form.

In the present work, the synthesis of the spine material was observed onpoly-ribosomes, then in the cytoplasm and the tubular cell extensions as membrane bounded secretory granules of variable size. Deep in the syncytium these secretory granules unite together to form the spine and their growth comes as a result of adding new secretory granules to the bse ofthe spine.

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REFERENCES

Bennett, C.E. and Threadgold, L.T. (1973): Electron microscope studies of Fasciola hepatica XIII. Fine structure of newly excysted juvenile. Experimental parasitology. 34, 85-89.

Bennett, C.E. and Threadgold, L.T. (1975): Fasciola hepatica: Development of tegument during migration in mouse. Experimental Parasitology. 38, 38-55.

Gallagher, S.S.E. and Threadgold, L.T (1967): Electron-microscope studies of Fasciola hepatica. II. The interrelationship of the parenchyma with other organ systems. Parasitology. 57, 627-632.

Threadgold, L.T. (1963): The tegument and associated strucutres of Fasciola hepatica. Q. Jl microsc. Sci. 104, 505-512.

Threadgold, L.T. and Gallaghes, S.S.E. (1966): Electron-microscope studies of Fasciola hepatica. I. The ultrastructure and interrelaionship of the parenchymal cells. Parasitology. 56, 299-304.

Threadgold, L.T. (1967): Electron-microscope studies of Fasciola hepatica. III further observations on the tegument and associated structures. Parasitology. 57, 633-637.

KEY OF FIGURES

Fig. 1: Electron micrograph of syncytium layer of F. gigantica tegument showing finger-like evagintions (E) covered by trilamillar plasma membran. Very dense secretory granules (G). X 20000.

Fig. 2: Electron micrograph of tegumental tube (T) penetrating the peripheral musculature (M) and contains large secretory granules of variable size (G). Plasma membrane of the tube (P). X 12000.

Fig. 3: Electron micrograph of tegumental dark cell having flask shape. Cytoplasm (C) is darkly stined. Nucleus (N) with clear nucleolus. X 8000.

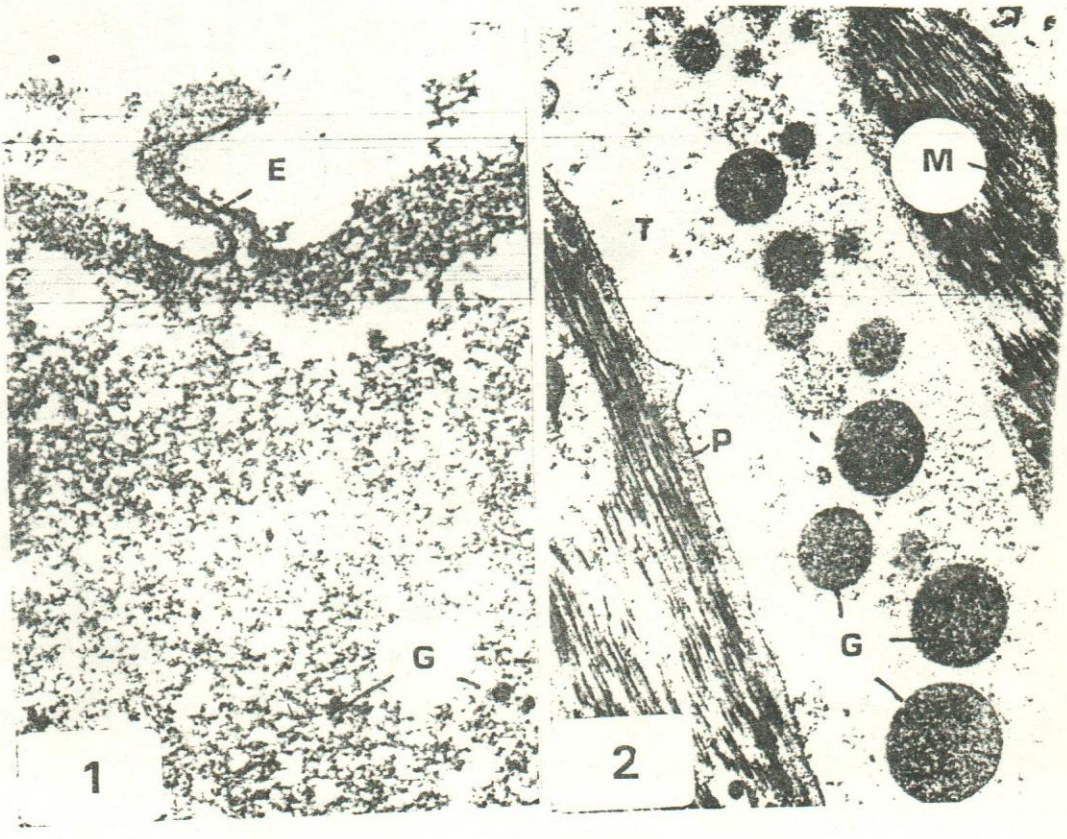
Fig. 4: Cytoplasm of dark tegumental cell showing numberous mitochondria (M), roughendoplasmic reticulum and free ribosomes (R) and very dense secretory granules (S). Nucleus (N), X 22000.

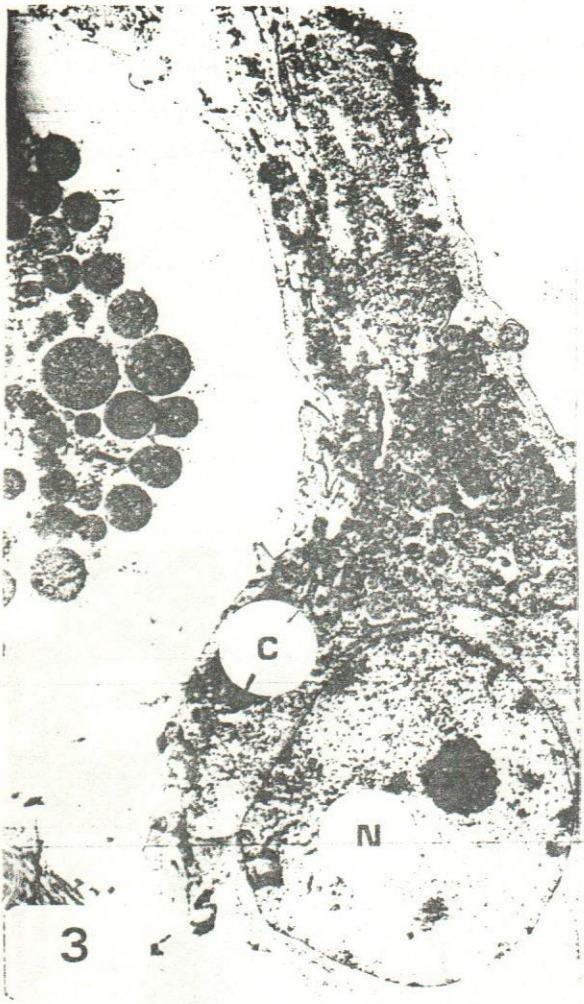
Fig. 5: At high magnification, cytoplasm of dark cell shw well-developed Golgy complex (Gc), very dense secretory granules (S), rough endoplasmic reticulum and free ribosomes (R). X 46000.

Fig. 6: Electron micrograph of light tegumental cell (L) found between dark cells (D). X 12000.

Fig. 8: Light tegumental cell showing many polyribosomes (Pr) and spherical secretory granules (Ss) atdifferent stages of synthesis. Dark tegumental cells (D). X 7000.

Fig. 9: Electron micrograph showing parenchymal cell (Pc) having cytoplasmic processes (Cp) in contact with dark tegumental cell (D). X 7000.





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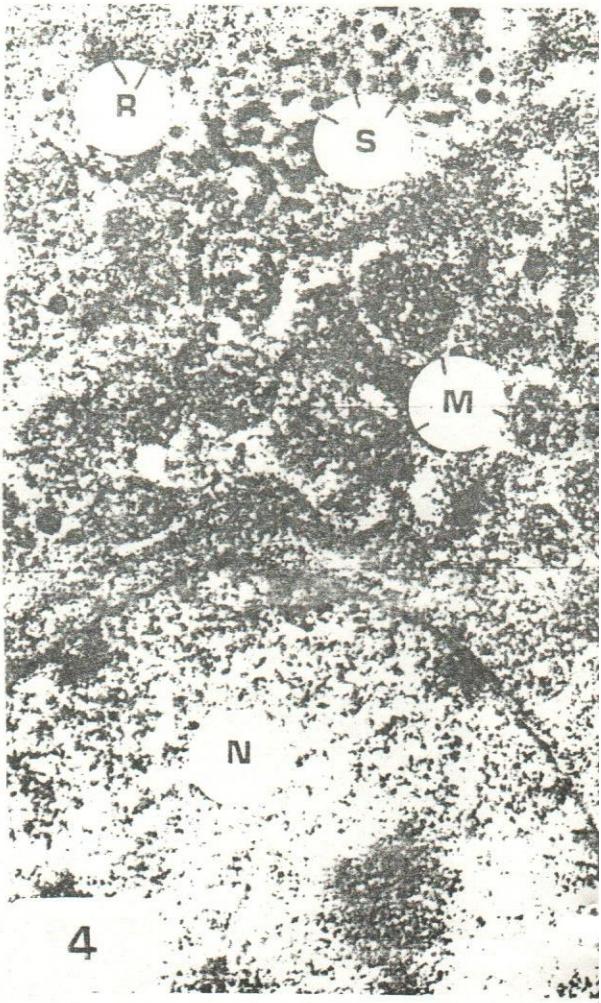

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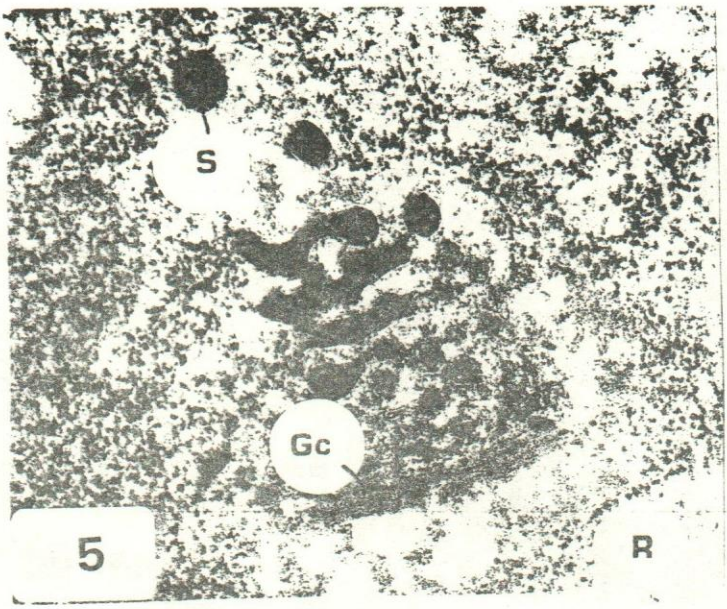
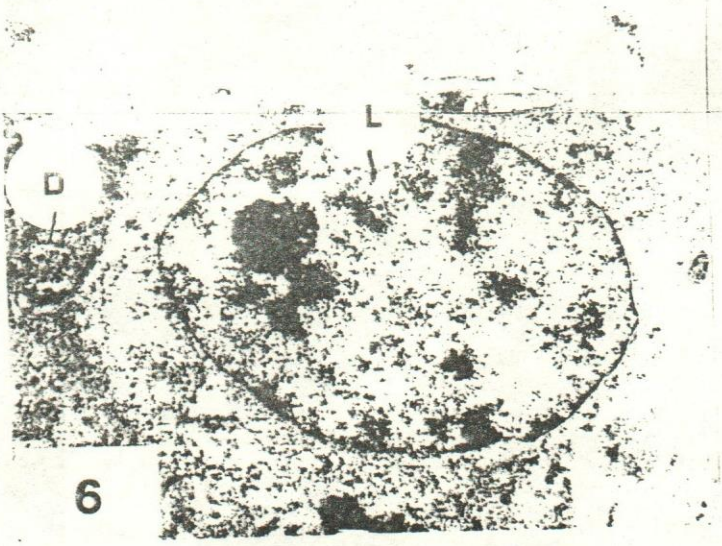
TEGUMENT, FASCIOLA GIGANTICA





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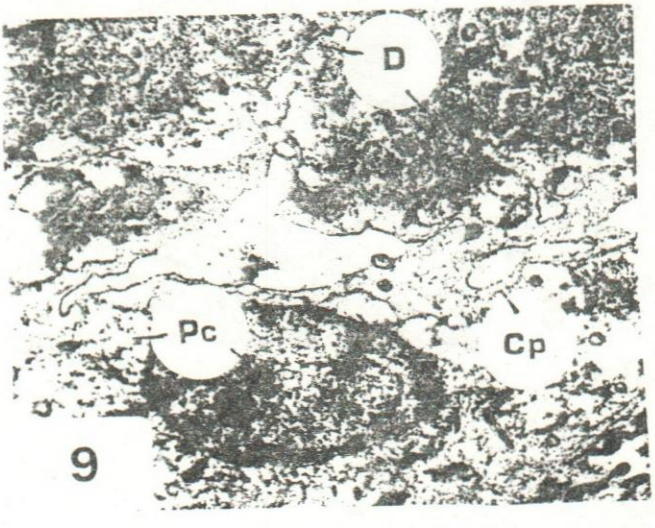

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