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Research Article

ZOOLOGY

A scanning electron microscopic study on *Meggittina gerbilli* Wertheim, 1954 and *Skrjabinotaenia oranensis* Joyeux and Foley, 1930 (Cyclophyllidea: Catenotaeniidae) from Rodents in Egypt.

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KEY WORDS

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ABSTRACT

Adult of *Meggittina gerbilli* collected from the greater Egyptian gerbil (*Gerbillus pyramidium pyramidium* Geoffroy, 1825) and the fat-tailed gerbil (*Pachyuromys duprasi natronensis* Lataste, 1880). *M. gerbilli* has few numbers of segments (3 to 6), with triangular-shaped scolex. Usually, the transversely elongate gravid segments are deeply cut posteriorly by a longitudinal fissure forming two lateral wings with serrated posterior end and irregular alternated genital openings. While, *Skrjabinotaenia oranensis* collected from the fat sand rat (*Psammomys obesus obesus* Crezschmar, 1828). *S. oranensis* is characterized by having more segments (3 to 16), with rounded-shaped scolex. Cirrus is provided with tiny hairs structures. Elongate undivided gravid segments with regular alternated genital openings. *M. gerbilli* and *S. oranensis* reveal dimorphic microtriches. Present scanning electron microscopic observations valid these taxonomic characters in the differentiation between *M. gerbilli and S. oranensis*. Moreover, the scanning has confirmed the presence of two distinct types of microtriches. Filitriches (papilliform and capilliform) were observed in *M. gerbilli*, while filitriches (capilliform*)* and spinitriches (small gladiate) in *S. oranensis*.

Introduction

Family Catenotaeniidae Spasskii includes two subfamilies; Catenotaenia Janicki, 1904 and Skrjabinotaeniinae Genov and Tenora, 1979 **(Tenora *et al.*, 1980 and Quentin, 1994)**. Subfamily Skrjabinotaeniinae have two main evolutionary lines genus *Skrjabinotaenia* Akhumyan, 1946 and *Meggittina* Lynsdale, 1953 **(Quentin, 1994)**. Genus *Skrjabinotaenia* includes the historically oldest forms, which are characterized by last gravid proglottid of the strobila longer than wide without a posterior longitudinal fissure, gradual shortening in the length of the strobila, and decrease in the number of proglottids through the different species. Members of this genus are distributed in Europe and Africa, in Muridae, Gerbillidae, Dendromuridae and Malagasy Cricetidae **(Quentin, 1994)**.

Genus *Meggittina* is derived from *Skrjabinotaenia* parasitic in North African Gerbillidae such as *Meriones shawi* and *M. libycus* **(Jrijer and Neifar (2014) and Khemiri *et al.*, (2017))**. In these tapeworms, the last gravid proglottid has some signs of a longitudinal fissure. **Quentin (1994)** reported that it is expanded to the rest of the African continent to Madagascar, adapting secondarily to other families of rodents; Muridae and Cricetidae **(Quentin, 1971 and Tenora *et al.*, 1980)**.

Tegumental microtriches in cestodes is considered as a valid taxonomic character between orders and families. **Richmond and Caira (1991)** suggested that studies on microtriches may be of great systematic and phylogenetic value. Microtriches involve in amplification of the absorptive surface, excretion, movement and external protection **(Jones 1998, Palm 2004)**, they are divided in two main types; filiform microtriches (or filitriches) and spiniform microtriches (spinitriches). **Faliex *et al.*, (2000)**, **Palm (2004) and Chervy (2009)** have described four types of filitriches and 25 types of spinitriches depending on the size, shape of tip and margin and architecture of the surface.

In the present study, specimens of *Meggittina gerbilli were* collected from the greater Egyptian gerbil, *Gerbillus pyramidium pyramidium* Geoffroy, 1825 and fat-tailed gerbil or jird, *Pachyuromys duprasi natronensis* Lataste, 1880, *and Skrjabinotaenia oranensis* were collected from fat sand rat, *Psammomys obesus obesus* Crezschmar, 1828. These tapeworms were examined for the first time by SEM in order to determine their ultrastructural characteristics, which would be used as

valid taxonomic characters for *M. gerbilli* and *S. oranensis*.

Materials and Methods

Adult worms of *M. gerbilli* collected from *Gerbillus pyramidium pyramidium* (the greater Egyptian gerbil) and *Pachyuromys duprasi natronensis* (Fat-tailed gerbil or jird). While adults of *Skrjabinotaenia oranensis* from *Psammomys obesus obesus* (Fat sand rat). Hosts collected from El-Hamam (30° 49' 54"N, 29° 22' 57"E), El-Dabaa (31° 1' 46"N, 28° 26' 52"E) and Borg El-Arab (30° 58' 56"N, 29° 41' 8"E), the North coast near to Marsa Matruh.

A total of 18 rodents were examined. Live trapes were used to collect these rodents. They were anesthetized by chloroform. The body cavity of each rat was opened and cut longitudinally. The gastrointestinal tract was removed and divided into esophagus, stomach, small and large intestines. Each part was examined separately.

For scanning electron microscopy (SEM), Cattenotaeniid worms were removed and washed three times in 0.9% buffered saline followed by washing in phosphate buffer solution. Specimens were fixed in 3% glutaraldehyde in 0.1 M phosphate buffer (pH 7.4) at 4°C, washed with buffer, fixed in 1% osmium tetraoxide in 0.1 M phosphate buffer solution. Then dehydrated, mounted, coated with gold, and examined with a JEOL (5300 JSM) scanning electron microscope at an accelerating voltage of 25 K.V. **(Allison *et al*., 1972)**

Results

Family: Catenotaeniidae Spasskii, 1950

***Meggittina gerbilli* (Wertheim, 1954)**

Host: *Gerbillus pyramidium pyramidium* Geoffroy, 1825 and *Pachyuromys duprasi natronensis* Lataste, 1880.

Site: Duodenum and the upper part of small intestine.

Scanning electron micrographs show that adult worm is a short minute and strongly reduced sized cestodes, where segments number ranged from 3 to 6 and apolytic. Adult looks like an arrow or a triangular-shaped. The maximum width at the gravid segments level **(Fig. 1a)**. Scolex is triangular to slightly rounded-shaped, unarmed with four rounded unarmed suckers and two shallow grooves. No rostellum or distinct neck **(Fig. 1b and c)**. Segmentation starts immediately posterior to the suckers. The immature segment is short, wider than scolex. Strobila are acraspedope and appear wider than long. Mature segment contains only one set of reproductive organs **(Fig. 1d)**. Genital atrium is round

cup shaped, alternating irregularly and situated at the anterior quarter of lateral margin of the segment **(Fig. 1d)**. The spermatozoids appear outside the atrium **(Fig. 1e)**. Often, gravid segment appears wide, deeply cut posteriorly with a longitudinal fissure forming two lateral wings with serrated posterior ends **(Fig. 1a)**. Genital opening appears simple and opens in shallow, rounded genital atrium. Eggs are smooth and oval **(Fig. 1f)**.

Tegumental surface of *M. gerbilli* is characterized by the presence of different types of microtriches. Size, and distribution of microtriches are vary between the different parts of the body. The tegument in the apical part of the scolex is covered with densely packed papilliform filitriches lying perpendicular to the surface **(Fig. 2a and b)**, while the tegumental surface in the suckers, scolex, immature, mature and gravid are covered with densely uniformly capilliform filitriches that are directed posteriorly **(Fig. 2b-h)**. The surface of the sucker appears as wrinkles due to the densely arranged microtriches **(Fig. 1c)**. Some of them appear with rounded tips **(Fig. 2f).**

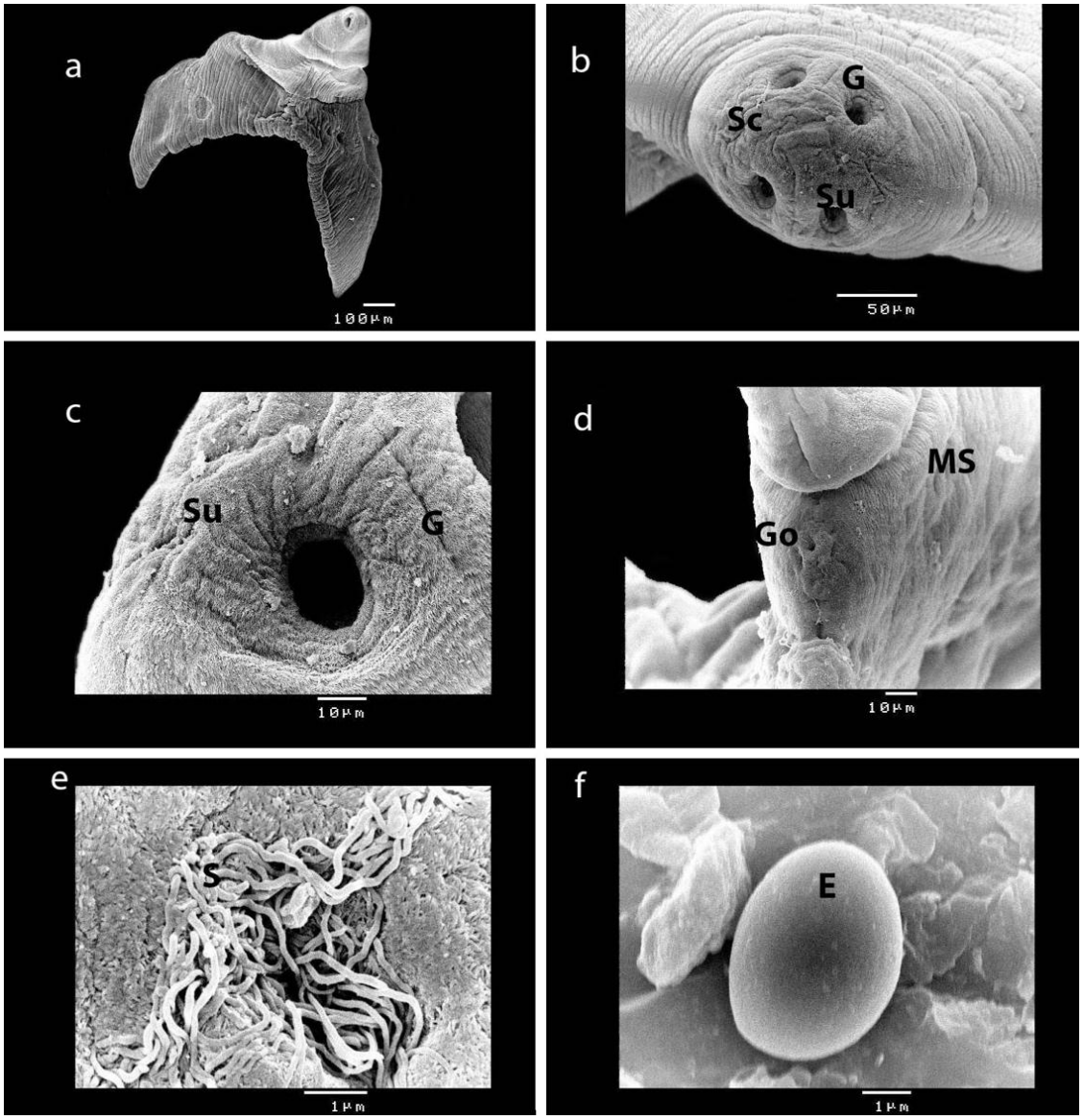

Fig. (1): *Meggittina gerbilli*, scanning electron micrographs of (a) whole body, (b) enface view of the scolex (Sc) showing four suckers (Su) and two grooves (G), (c) higher magnification of rounded-shape sucker (Su), (d) acraspedode mature segments (MS) with lateral genital opening (GO), (e) genital atrium in mature segment with spermatozoids, (f) egg (E).

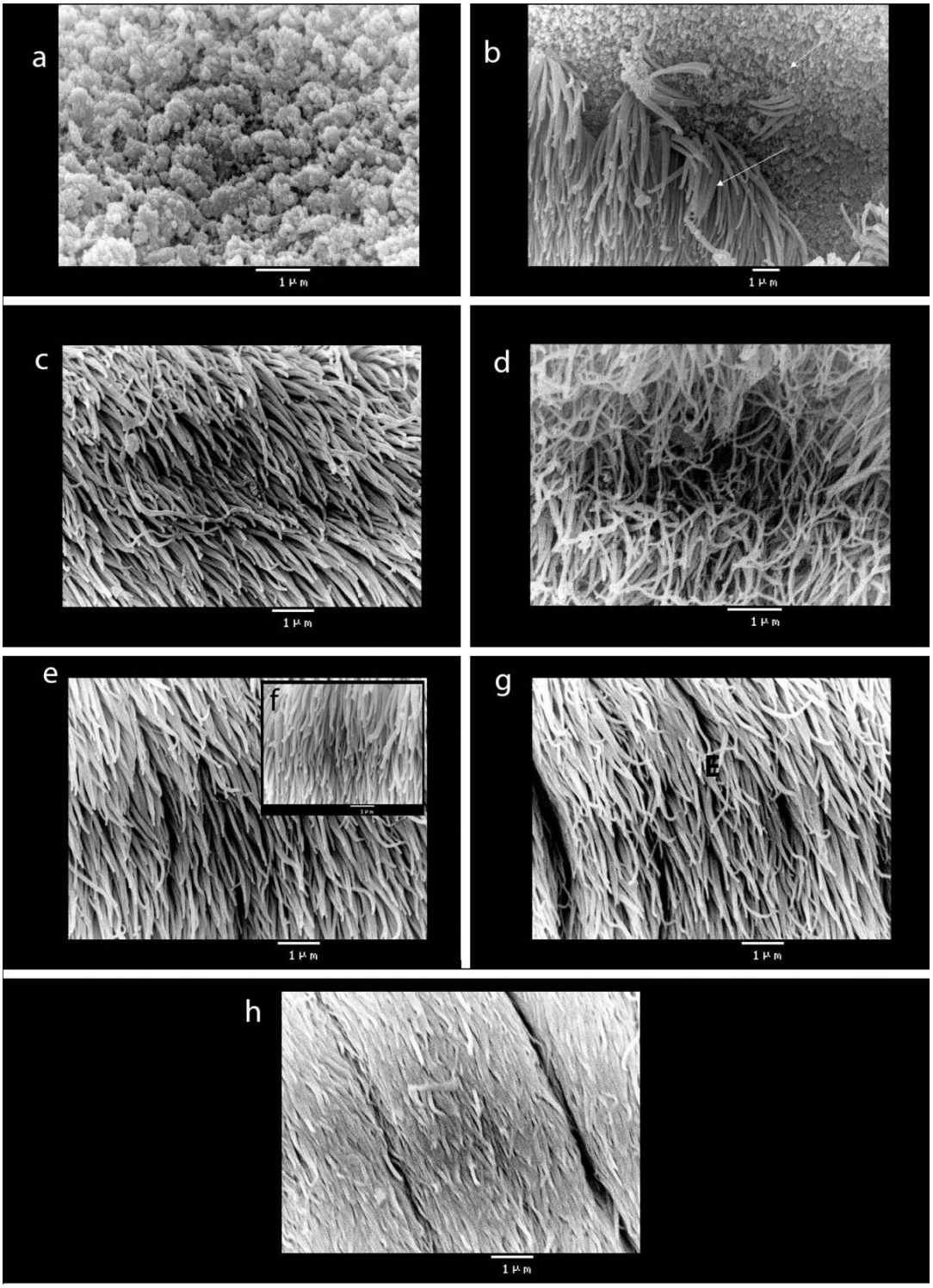

Fig. (2): *Meggittina gerbilli,* scanning electron micrographs of microtriches showing different shape, size and orientation (a) densely packed papilliform filitriches at the top view of the scolex, (b) papilliform with capilliform filitriches at the apical part of the scolex showed by arrows, *capilliform* filitriches in (c) sucker (d) at the inner edge of sucker tegument (e) scolex and (f) mature segment, (g) gravid segment.

***Skrjabinotaenia oranensis* Joyeux and Foley, 1930**

Host: *Psammomys o. obesus* Crezschmar, 1828

Site: small intestine.

Scanning electron micrographs show that worms are long and ranged from 3- 16. Segments are acraspedote and apolytic with maximum width at the gravid segments level **(Fig. 3a and d)**. Scolex is unarmed and rounded in shape, it carries four lateral suckers and two deep grooves. Suckers are unarmed and oval. Rostellum is absent **(Fig. 3a-c)**. Segmentation starts immediately posterior to the suckers **(Fig. 1a)**. Mature segments appear wider than long and possesses one set of reproductive organs in each segment. Genital atria are alternating irregularly. Cirrus is covered with tiny hairs **(Fig. 3 e-f)**. Gravid segments are longer than wide with rounded end, some segments with slightly forked end **(Fig. 3g)**. The shape of the last gravid segment of *S. oranensis* varies in relation to the number of segments. Genital opening appears simple and opens in rounded genital atrium. Spermatozoids appears outside the genital opening. Eggs are smooth and spherical in shape **(Fig. 3h)**.

In *S. oranensis*, the tegumental microtriches are vary in the size, thickness and distribution according to their position in the body. The length and thickness of the microtriches increase gradually begin at the apical part of the scolex until reach the immature segments, then start to decrease until reach the gravid segments.

Capilliform filitriches covered the tegumental surface of the apical part of the scolex **(Fig. 4a)**. Suckers and distal part of the scolex is covered with small gladiate spinitriches **(Fig. 4b and c)**. Immature, mature and gravid segments are covered with uniformly capilliform filitriches **(Fig. 4d-f)**. Microtriches are always directed posteriorly.

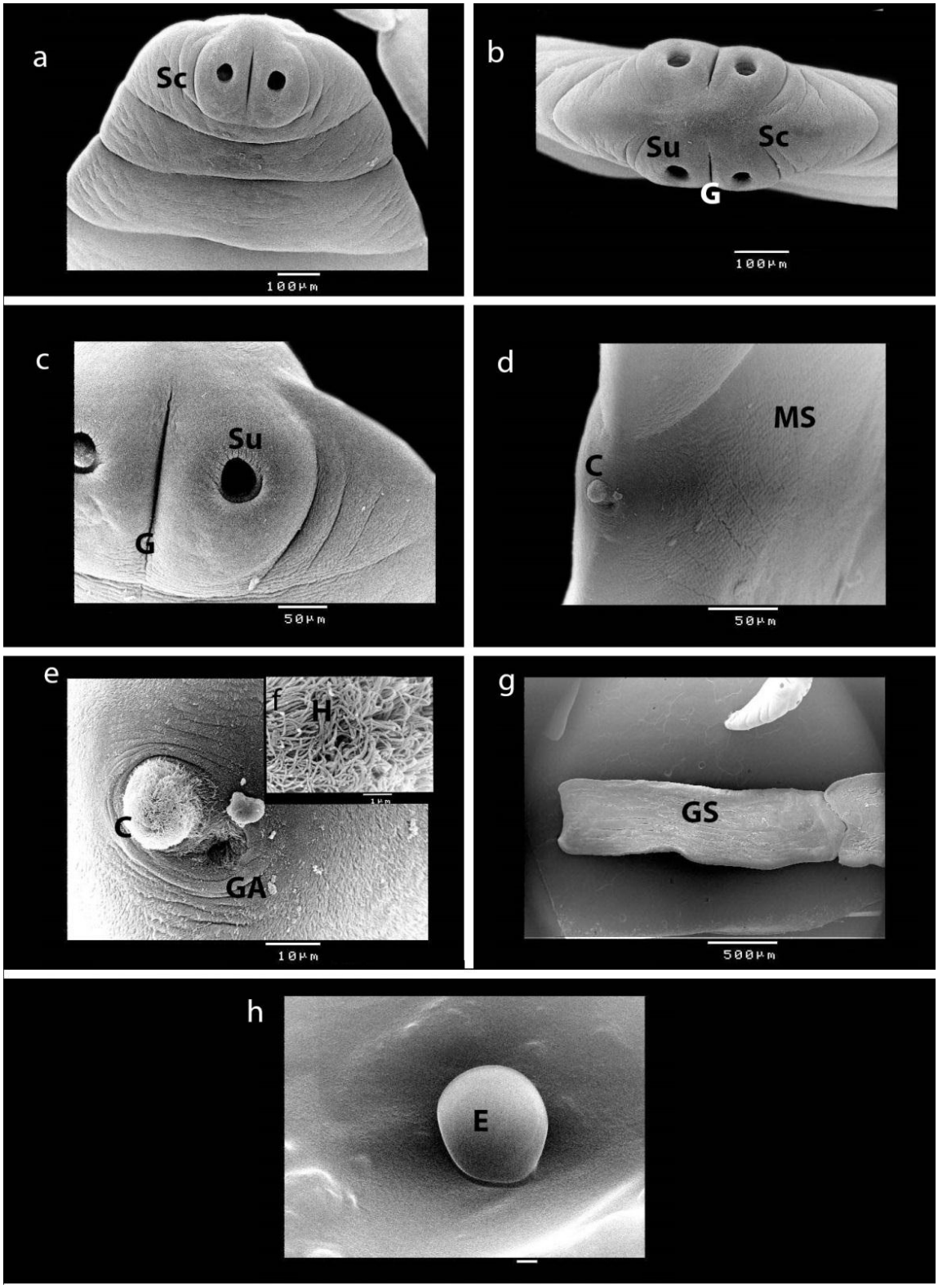

Fig. (3): *Skrjabinotaenia oranensis*, scanning electron micrographs (a) lateral view showing the rounded shape scolex (Sc), (b) enface view of the scolex showing the four lateral suckers (Su) and two deep grooves (G), (c) higher magnification of sucker (Su), (d) acraspedote mature segment (MS) showing the genital atrium, (e) genital atrium with everted hairy cirrus (C), (f) magnification of hair structure (H) on the cirrus, (g) gravid segment (GS) with slightly forked end, (h) egg (E).

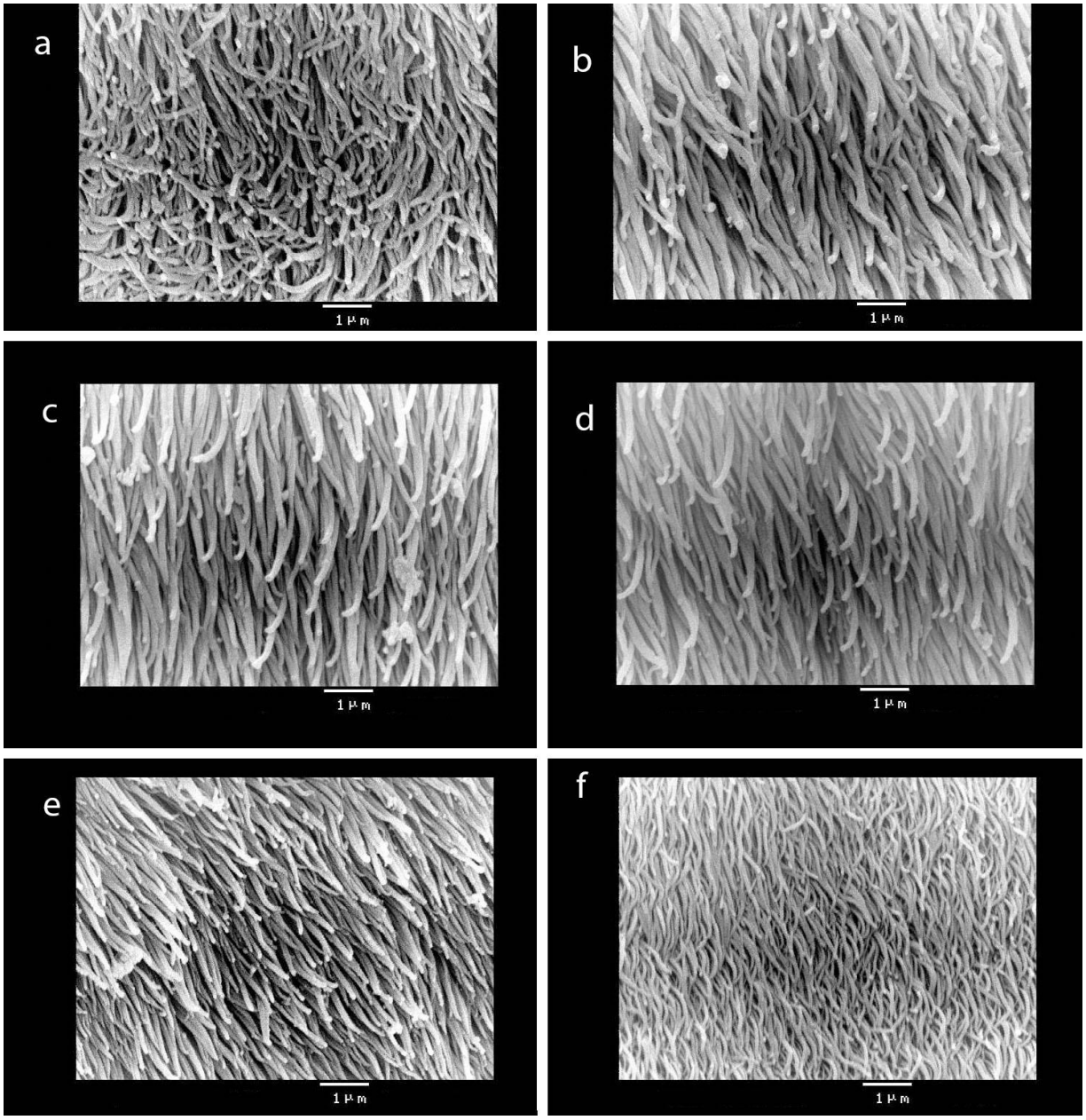

Fig. 4: *Skrjabinotaenia oranensis*, scanning electron micrographs of microtriches showing different shape, size and orientation (a) *Capilliform* filitriches at the apical part of the scolex, (b & c) small gladiate spinitriches in sucker and distal part of scolex, Capilliform filitriches in (d) immature segment, (e) mature segment and (f) gravid segment.

Discussion

In this study, two tapeworm species, *Meggittina gerbilli* and *Skrjabinotaenia oranensis*, belonging to family Catenotaeniidae and subfamily Skrjabinotaeniinae, were collected from Egyptian rodents to determine their ultrastructural characteristics. To date, this the first ultrastructural study on *M. gerbilli* and *S. oranensis* in the whole world including Egypt.

Both species understudy are characterized by round scolex with four suckers, absence of apical sucker, mature and gravid segments are elongated either transversely or longitudinally, mature uterus with a median stem with lateral branches (taenioid type), genital apparatus single, irregularly alternating genital atrium that are situated at anterior third of segment. These characters placed both species under family Catenotaeniidae **(Yamaguti, 1959 and Quentin, 1994)**. *M. gerbilli* and *S. oranensis* are fully described by **Elmahi (2012)** from the same host (*Gerbillus p. pyramidium, Pachyuromys duprasi natronensis* and *Psammomys o. obesus*).

Family Catenotaeniidae includes two subfamilies: Catenotaenia and Skrjabinotaeniinae **(Quentin, 1994)**. The validity of the genera especially *Catenotaenia* Janicki, 1904, *Meggitina* Lynsdale, 1953 and *Skrjabinotaenia* Akhumyan, 1946 has been the subject of many controversial reports.

M. gerbilli is considered as the only member in the genus *Meggittina* in Egypt. The present study confirms the specific characters related to this genus, which are strong reduction of the body, one set of genitalia, acraspedote segments, small scolex with four suckers, wide gravid segment with lateral wings, regular alternating genital pores situated on the anterior margin of the segment. In Egypt, this species has been reported in different synonyms by **Wertheim (1954), Wolfgang (1956), Mikhail and Fahmy (1969), Fahmy *et al.*, (1971), Wertheim *et al.*, (1986) and Elmahi (2012).**

The present study proves that *S. oranensis* has many characters that distinguish its genus namely; numerous wide mature segments, acraspedote, tiny hairs on inner surface of cirrus, elongate undivided gravid segments, irregular alternative genital openings. In Egypt, the genus *Skrjabinotaenia* represents in only two species *Catenotaenia oranensis* (syn. of *Skrjabinotaenia oranensis*) and *Skrjabinotaenia psammomi* **(Wolfgang, 1956; Mikhail and Fahmy, 1969; Fahmy *et al.*, 1971; and Elmahi, 2012)**.

In the present, scanning electron microscopic observations valid the taxonomic characters in the

differentiation between *M. gerbilli* and *S. oranensis.*

Microtriches are represented in the understudied species by two basic types filitriches (tubular or cylindrical with pointed tip and basal widths of ≤200 nm) and spinitriches (broad with basal widths >200 nm). These two types are treated as symplesiomorphic character in cestodes. They are common feature in many orders, such as pseudophyllidea, cyclophyllidea, tetrphyllidea **(Ruhnke, 1994; Hoberg *et al*., 1995)**.

Present observation detected that the filitriches (filiform microtriches) are the most common type in *M. gerbilli* and *S. oranensis*. *M. gerbilli* have only filitriches which are distributed on apical and lateral margin of the scolex, sucker, immature, mature and gravid segments. *S. oranensis* have filitriches on apical part of scolex, immature, mature and gravid segments, while the sucker and the lateral margin of the scolex are covered with spinitriches. Filitriches is represented in two types; papilliform (only in *M. gerbilli*) and capilliform (in both species). Capilliform filitriches are the most common and longest type (>6 times as long as they are wide) in both species. While spinitriches represent as small gladiate. **Chervy (2009)** reported that Gladiate is one of the most common and encountered type of spinithrix in a wide range of cestode orders including cyclophyllideans. The present results agree with **Berger and Mettrick (1971), Ubelaker *et al*., (1973) and Elmahi (2012)** who reported papilliform, spiniform, and filiform structures among cyclophyllidean cestodes. It could be concluded that the structural differences in the microtriches along the scolex and segments of cestode might be expected because in many cestodes, different regions of the strobila are in different parts of the small intestine **(Mettrick and Podesta, 1974)**. In the present study, microtrichial dimorphism usually occurs at the anterior end of the worm, on the scolex, while in immature, mature and gravid segments are uniformly capilliform filitriches. The length of Capilliform filitriches helps to stir the surrounding environment, increases the surface area, which suggests their nutritional function in the intestine. The small size of the species understudy and their site in the host explain the presence of filiform microtriches as the most common type in different parts of the body.

Conclusion

The ultrastructural characters observed in the present study could be used as valid taxonomic characters in the differentiation between *M. gerbilli* and *S. oranensis.*

References

Allison, V.; Ubelaker, J.; Webster Jr.R.; and Riddle, J. (1972). Preparations of Helminths for Scanning Electron Microscopy. *J. Parasitol*., **58**(2): 414-416.

Berger, J. and Mettrick, D.F. (1971). Microtrichial polymorphism among hymenolepidid tapeworms as seen by scanning electron microscopy. *Trans. Am. Microsc. Soc.*, **90**: 393-403.

Chervy, L. (2009). Unified terminology for cestode microtriches: a proposal from the International Workshops on Cestode Systematics in 2002–2008. *Folia Parasitol*., **56**(3): 199-230.

Elmahi, R.A. (2012). Flatworms of some wild mammals with special reference to Hymenolepidids from Egypt. Ph. D. Thesis, Faculty of Science, Tanta University, Egypt.

Fahmy, M.A.M.; Mikhail, J.W.; and McConnell, E. (1971). A survey of the helminth parasites collected from Egyptian small mammals. *J. Egypt. Soc. Parasitol.*, **1**: 47-58.

Faliex, E.; Tyler, G.; and Euzet, L. (2000). A new species of *Ditrachybothridium* (Cestoda: Diphyllidea) from *Galeus* sp. (*Selachii*, Scyliorhynidae) from the South Pacific Ocean, with a revision of the diagnosis of the order, family, and genus and notes on descriptive terminology of microtriches. *J. Parasitol.*, **86** (5): 1078-1084.

Hoberg, E.P.; Slims, D.E.; and Odense, P.H. (1995). Comparative morphology of the scolices and microtriches among five species of *Tetrabothrius* (Eucestoda: Tetrabothriidae). *J. Parasitol*., **81**(3):475-81.

Jones, M.K. (1998). Structure and diversity of cestode epithelia. *Int. J. Parasitol.*, **28**: 913–923.

Joyeux, C. and Foley, H. (1930). Les helminthes de *Meriones shawi shawi* Rozet dans le nord de l'Algérie. Bulletin de la Société Zoologique de France **55**:353-374. Quoted from Mikhail and Fahmy (1969).

Jrijer, J. and Neifar, L. (2014). *Meggittina numida* n. sp. (Cyclophyllidea: Catenotaeniidae), a parasite of the Shaw's jird Meriones shawi (Duvernoy) (Rodentia: Gerbillinae) in Tunisia. *Systematic Parasitol*. **88(2):**167-174.

Khemiri, H.; Jrijer, J.; Neifar, L.; and Nouira, S. (2017). A survey study on the helminth parasites of two wild jirds, *Meriones shawi* and *M. libycus*(Rodentia: Gerbillinae), in Tunisian desert areas. *Euro. Zool. J.*, 84(1).

Levron, C.; Scholz, T.; and Dezfuli, B. S. (2008). Ultrastructure of microtriches on the scolex of *Cyathocephalus truncatus* (Cestoda: Spathebothriidea). *Folia parasitol. (Praha)*, **55**(4):309-312.

Mettrick, D.F. and Podesta, R.B. (1974). Ecological and physiological aspects of helminth-host interactions in the mammalian gastrointestinal canal. *Advan. Parasitol.*, **12**:183-278.

Mikhail, J.W. and Fahmy, M.A.M. (1969). Study on some members of the genus *Skrjabinotaenia* with a description of a new species and a review of the subfamily Catenotaeniinae Spasski, 1946. *Zool. Anz.*, **181**: 439-450.

Palm H.W. (2004). The *Trypanorhyncha* Diesing, 1863. PKSPLIPB Press, Bogor, 710 pp. Quoted from Levron et al. (2008)

Quentin J.C. (1994). Family Catenotaeniidae Spasskii, 1950. pp. 367-374 in Khalil, L.F.; Jones, A.; and Bray, R.A. (eds) Keys to the Cestode Parasites of Vertebrates. Wallingford, UK : Commonwealth Agriculture Bureaux International.

Quentin, J.C. 1971. Cestodes *Skrjabinotaenia* de rongeurs murdies et dendromurides de Centrafrique. Hypothese sur l'evoultion des cestodes Catenotaeniinae. Cah. Maboké **5**: 57-79.

Richmond C. and Caira J.N. (1991). Morphological investigations into *Floriceps minacanthus* (Trypanorhyncha: Lacistorhynchida) with analysis of the systematic utility of scolex microtriches. *Sys. Parasitol.*, **19**: 25–32.

Ruhnke, T.R. (1994). *Paraorygmatobothrium barberi* n. g., n. sp. (Cestoda: Tetraphyllidea), with amended descriptions of two species transferred to the genus. *Sys. Parasitol.*, **28**(1): 65–79.

Tenora, F.; Mas-Coma, S.; Murai, E.; and Feliu, C. (1980). The system of the suborder Catenotaeniata Spassky, 1963. *Parasitol. Hung*., **13**: 39-57.

Ubelaker, J.E.; Allison, V.F.; and Specian, R.D. (1973). Surface topography of *Hymenolepis diminuta* by scanning electron microscopy. *J. Parasitol*., **59**: 667-671.

Wertheim, G. (1954). A new anophlocephalid cestode from the gerbil. *Parasitol.*, **44**: 446-449.

Wertheim, G.; Schmidt, G.D.; and Greenberg, Z. (1986). *Witenbergitaenia sinaica* gen. n., sp. n. (Anoplocephalidae) and other cestodes from small mammals in Israel and in the Sinai Peninsula. Bull. Mus. Natl. Hist. Nat. Zool, France, **8**(3): 543-550.

Wolfgang, R.W. (1956). Helminth parasites of reptiles, birds, and mammals in Egypt: II. *Catenotaenia aegyptica* sp. Nov. from Myomorph rodents, with additional notes on the genus. *Can. J. Zool*., **34**(1): 6–20.

Yamaguti, S. (1959). Systema helminthum, vol. II- The cestodes of vertebrates, Interscience Publishers. *Inc., N. Y. and London.* pp. 446-448.

دراسة مجهرية دقيقة لطفيلي ميجيتنا جربلي و سكارجابينوتينيا اورانينسيس (دائرية الممصات: كاتينوتانيدي) من القوارض في مصر

رشا الماحي

قسم علم الحيوان- كلية العلوم- جامعه طنطا

أجريت هذه الدراسة بهدف البحث عن صفات تصنيفية لنوعين من الديدن الشريطية الموجودة في انواع من القوارض المصرية باستخدام المجهر الالكتروني الماسح. وقد أوضحت نتائج هذه الدراسة أن طفيلي *ميجتينا جربلي*، المجمع من *الدمسى* (*جربيلس بيراميديم بيراميديم*) و الفار أبو ليه او الجيرد (*باكيرومس دبراسي ناترونينسيس*)، يتميز بعدد محدود من الاسلات (٣ إلى ٦ عقل) وهي ذات رأس مثلثي الشكل. وتكون أسلاتها المحملة بالبيض عريضة الشكل وذات شق طولي يقسمها الي جناحين جانبيين بنهاية خلفية ذات حافة مسننة. الفتحات تناسلية متناوبة وغير منتظمة التوزيع. بينما يتميز طفيلي *سكارجابينوتينيا اورانينسيس*، المجمع الجرد او جرذ الرمل السمين (*باسيمومس اوبيسس اوبيسس*)، بوجود عدد أكبر من الأسلات (٣ إلى ١٦عقله)، مع رأس مستدير الشكل. كيس الذؤابة مدعم بشعيرات دقيقة. الأسلات المحملة بالبيض تكون مستطيله الشكل وغير مقسمة. الفتحات التناسلية متناوبة ومنتظمة التوزيع. وفي كلا من النوعين من الديدان يتميز شكلين من الميكروتريتش: الشكل الخيطي (على شكل خيوط رفيعة وطويله الشكل وعرض قاعدتها اقل او يساوي تقريبا ٢٠٠ نانومتر) والشكل الشوكي (تكون عرض قاعدتها أكبر من ٢٠٠ نانومتر) والمنتشرة على أجزاء مختلفة من الجسم في كلا النوعين. اكدت الدراسة الحالية أهمية هذه الصفات التصنيفية في التمايز بين طفيلي *ميجتينا جربلي* وطفيلي *السكارجابينوتينيا اورانينسيس*.