

Tegument of monozoic tapeworms (Cestoda: Caryophyllidea): TEM and SEM studies

C. Levron¹

1. Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic

levron@paru.cas.cz

Keywords: Cestoda, Caryophyllidea, tegument, microtriches

Tapeworms of the order Caryophyllidea, possibly the earliest branching group of true Cestoda (Platyhelminthes, Eucestoda), are intestinal parasites of freshwater fishes with an almost global distribution [1]. They are characterized by a lack of internal or external segmentation and a single set of reproductive organs, i.e. they are monozoic unlike all other eucestodes.

The systematics of the Caryophyllidea and its position among the basal tapeworms are still unresolved even when using molecular data [2]. A recent study on phylogenetic relationships of this order highlighted a limited number of morphological characters available for analyses [3].

The tegument (external surface) of cestodes is covered with a specialized structure named microtriches, which represents one of the most remarkable apomorphy of these parasitic flatworms [4]. Studies on microtriches suggest that they may be of systematic and phylogenetic importance [5]. The morphology of microtriches has been found to vary among species, life-cycle stages and body regions [6]. Two main types of microtriches have been described in cestodes, filitriches (i.e. filiform microtriches) and spinitriches (i.e. spiniform microtriches), each including several subtypes depending on their length and shape [7].

The ultrastructure of the tegument of the following six species of the Caryophyllidea belonging to two families has been studied using scanning and transmission electron microscopy: *Archigetes sieboldi*, *Caryophyllaeus laticeps* and *Wenyonia virilis* (Caryophyllaeidae), *Atractolytocestus huronensis*, *Caryophyllaeides fennica* and *Khawia sinensis* (Lytocestidae).

Only filiform type of microtriches has been found in the six species studied. However, two different subtypes can be distinguished based on their length and localization along the body. Acicular filitriches, approximately 1.5 µm long, cover the scolex and the main part of the body (Fig. 1a). Papilliform filitriches, approximately 0.4 µm long, are observed on the posterior part (Fig. 1b). Both types of microtriches are composed of an electron-dense cap with microfilaments, a baseplate and an electron-lucent base (Fig. 1e, f). Sensory bulbs were observed in the distal cytoplasm of all species mainly in the scolex region (Fig. 1c). The distal cytoplasm is characterized by the presence of numerous electron-dense structured bodies (Fig. 1c, f).

The structure of the tegument of the six species studied does not differ markedly from that found previously in other caryophyllideans [8]. The main characteristic is the presence of electron-dense structured bodies described in details by Richards and Arme [9]. The presence of only filiform type of microtriches seems to be a characteristic of lower cestodes [10], but it is still unclear in what group of cestodes spinitriches first appeared during the evolution of tapeworms. Our results represent evidence about the placement of caryophyllideans among the most basal groups of cestodes.

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11. We are grateful to the staff of the Laboratory of Electron Microscopy, Institute of Parasitology, České Budějovice, Czech Republic, for technical assistance. This study was supported by the Grant Agency of the Czech Republic (projects Nos. 524/07/P039 and 524/09/0885) and the Institute of Parasitology (Z60220518 and LC 522).

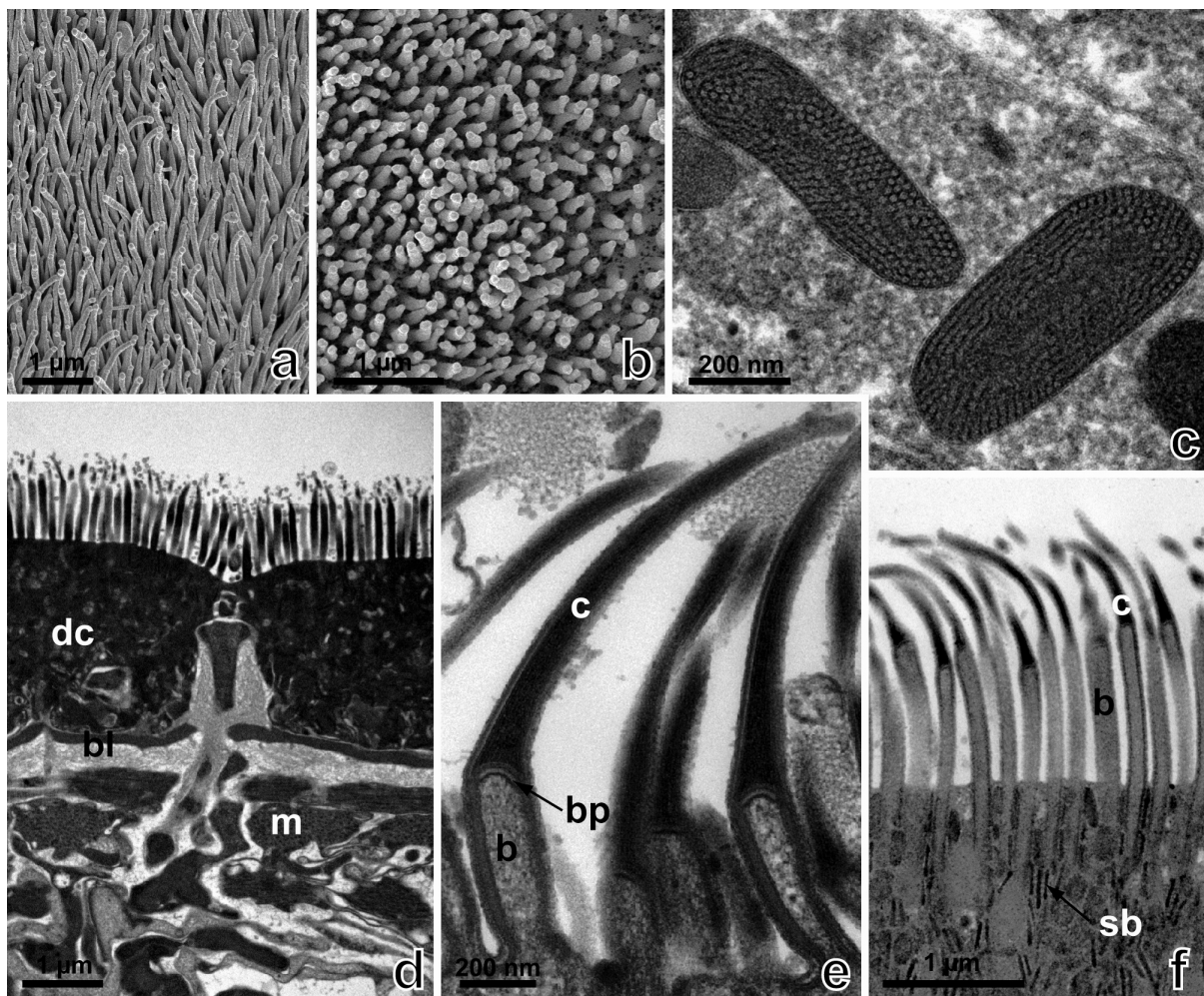


Figure 1. **a.** SEM photomicrograph of microtriches on the scolex of *Caryophyllaeus laticeps*. **b.** SEM photomicrograph of microtriches on the posterior part of *C. laticeps*. **c.** TEM photomicrograph of structured bodies in *Khawia sinensis*. **d.** TEM photomicrograph of the tegument of *Archigetes sieboldi* with sensory bulb. bl, basal lamina; dc, distal cytoplasm; m, muscles. **e.** TEM photomicrograph of microtriches of *Caryophyllaeides fennica*. b, base; bs, baseplate; c, cap. **f.** TEM photomicrograph of microtriches of *C. fennica* with structured bodies (sb). b, base; c, cap.