STRUCTURE OF THE ANTERIOR ALIMENTARY TRACT OF THE PASSIVELY FEEDING NEMATODE HEXATYLUS VIVIPARUS (NEOTYLENCHIDAE: TYLENCHIDA)

BY

AUDREY M. SHEPHERD and SYBIL A. CLARK

Rothamsted Experimental Station, Harpenden, Herts., England

Following the observations of Doncaster & Seymour (1974) that H. viviparus passively ingests the contents of fungal cells, electron microscopy has confirmed that modifications to some features of the anterior alimentary tract are associated with this method of feeding. These we have interpreted as follows. The oesophagus is a straight tube with a very narrow, oval-shaped, cuticle-lined lumen, of the same cross-sectional area as the stylet lumen (about 0.02-0.03 µm²). At no point is the lumen triradiate. The oesophagus leads, via the oesophago-intestinal valve, into an anterior-intestinal region which also has a narrow lumen (about 1 µm across) lined with short microvilli. This in turn leads into the mid intestine, which has a much wider lumen lined with long microvilli that, unlike those of the anterior intestine, have a sculptured outer coat. The oesophageal glands lie alongside the anterior intestine and the gland ducts pass up through the oesophageal wall. The two subventral gland ducts enter the oesophageal lumen anterior to the oesophago-intestinal valve and the dorsal gland duct enters just behind the stylet base. There is no musculature or other contractile tissue associated with the oesophagus. The nerve ring is circum-intestinal.

In Hexatylus i?ivip?zrar.r T. Goodey, which feeds on fungal hyphae, the oesophagus has no median bulb and no associated musculature can be seen with the light microscope. Nickle (1968) reviewed earlier descriptions of the digestive tract; in all of these, the region anterior to the nerverting was interpreted as the “anterior oesophagus” and that immediately posterior to it, with which the oesophageal gland nuclei were associated, as the “posterior oesophagus”, since both had a narrow lumen. Nickle, however, postulated that this “posterior” region was part of the intestine, and that the junction seen just anterior to the nerve ring was the oesophago-intestinal junction.

Doncaster & Seymour (1974) provisionally reverted to the original interpretation and called the regions the anterior and posterior pharynx. These authors concluded that in this nematode ingestion of fungal contents occurred passively.

We studied the structure of the anterior alimentary tract of H. viviparus, using the transmission electron microscope.

MATERIALS AND METHODS

Adult females of H. viviparus were maintained on agar-plate cultures of Botrytis cinerea Fr. They were prepared for thin sectioning by fixing at 5° for 24 h in 6% glutaraldehyde in cacodylate buffer at pH 7.2 (they were still moving after 7 hr in the fixative), after which the anterior third of the body was cut off and embedded in 1% Ionagar (Wright & Jones, 1965). The small agar blocks
containing the specimens were then returned to the fixative for another 1 hr after which they were rinsed six times in buffer, post-fixed in 1% OsO₄ in veronal acetate buffer for 3 hr, rinsed, dehydrated in an alcohol series and finally infiltrated and embedded in low viscosity epoxy resin (Spurr, 1969). Longitudinal and transverse serial sections, approximately 50 nm thick (silver-coloured), were cut with a diamond knife on an ultramicrotome. The sections were mounted on large-slot grids coated with pyroxylin film, or on uncoated 300 or 300/75 mesh grids. They were stained in 0.9% potassium permanganate in 0.1 M phosphate buffer at pH 6.5 for 1 min (Soloff, 1973), rinsed in buffer, then in distilled water, and stained in 3% aqueous uranyl acetate for 45 min and in Reynold’s (1963) lead citrate for 10 min, all at room temperature.

OBSERVATIONS

Stylet. The stylet (st) of *H. viviparus* is hollow, about 9 μm long, and about 0.8 μm wide at the shaft (ss), narrowing to a point at the tip (Fig. 2 a-h). The lumen (sl) is 0.2 μm wide and the orifice (so) is about 1 μm from the tip on the ventral surface of the stylet. The sclerotised material of which the stylet is made is of two types, seen in transverse sections as alternating bands of very electron-dense and less dense material. Towards the base, the very dense material predominates. The three knobs at the base of the stylet each bifurcate, producing six flanges (sf) to which the stylet protractor muscles (spm) attach. The stoma is 5 μm long and lined with cuticle (sc) (Fig. 2 a, i). This cuticle has an A₁ layer (a) (see Shepherd, Clark & Dart, 1972) inside which is a strongly osmiophilic layer (dc), with an electron-translucent layer (tc) innermost. The cuticular lining of the stoma is attached to the stylet shaft one third of the stylet length from the tip, so that the posterior two thirds of the stylet are embedded in hypodermal tissue (hc). These hypodermal cells have osmiophilic tight junctions at intervals, especially where they meet the stylet shaft (tj in Fig. 2 j).

Oesophagus. The oesophagus is a straight tube (Fig. 1 a), about 60 μm long, completely without musculature but well supplied with nerves (n) (Figs. 3 a, 4). The lumen of the stylet is continuous with the oesophageal lumen, which is very narrow and lined with electron-dense cuticle. In the fixed nematode, the lumen is oval (ol in Fig. 3 d), or sometimes almost hour-glass shaped in transverse section (Fig. 3 b), and its small size is maintained along its whole length (Fig. 1 a-f). The dimensions of the lumen are 0.3-0.5 μm across the wider diameter and about 0.08 μm across the narrow, and the cuticular lining is about 0.06 μm thick. At no point is the lumen triradiate.

The oesophagus is cellular, not syncytial, and the cell junctions abutting the lumen are very electron-dense, sometimes where they join the cuticular lining (tj in Fig. 3 b), sometimes a short distance from it (Fig. 3 d). The non-contractile cell bodies (spc) of the three stylet protractor muscles are embedded in the oesophageal tissue just behind the stylet base (Figs. 1 b, 3 a, 4). Groups of cells within the boundary of the oesophagus appear to be nerve tissue (n) (Figs. 1 b,