

## Sym. triazinone (toltrazuril) effective against fish-parasitizing Monogenea

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Sym. triazinone (toltrazuril, Code No Bay Vi 9142), which has been shown to be an anticoccidial drug (Haberkorn 1986; Haberkorn and Stoltefuss 1987; Haberkorn et al. 1983; Mehlhorn et al. 1984), is also effective against Monogenea parasitizing the gills or external surface of fish. Naturally infected carps, breams, roaches, eels, and three-spined sticklebacks parasitized by *Dactylogyrus vastator*, *D. extensus*, *D. cornu*, *Diplozoon homoion*, *Pseudodactylogyrus bini*, and *Gyrodactylus arcuatus* were incubated in water containing 0.5, 10, 20, 30, or 50 µg toltrazuril/ml for 0.3, 1, 2, 3, and 4 h. The pure solvent (4 ml/1000 ml water) had no effect on either the fish or parasites.

Toltrazuril caused irreversible damage to the tegument of *Dactylogyrus* species and *P. bini*, beginning at a dose of 5 µg/ml and 4 h exposure. In vitro treatment with toltrazuril causes death in *D. paradoxum* (host = chub) and *D. homoion* after 4–80 min (10 µg/ml), depending on the age of the parasites. Specimens of *G. arcuatus* were severely affected after treatment with 20 µg/ml for 1 h. In all species, the teguments of the prohaptor and peduncle showed marked vacuolization and disruptions.

We recommend that infections in *Gyrodactylus* and *Dactylogyrus* species and *P. bini* be treated using a water bath with 10 µg toltrazuril/ml for 4 h at 20° C (breams and roaches: 15° C) under good aeration. Fish with extensive skin lesions (due to other infections) should carefully be observed during treatment, because this factor decreases their drug tolerance.

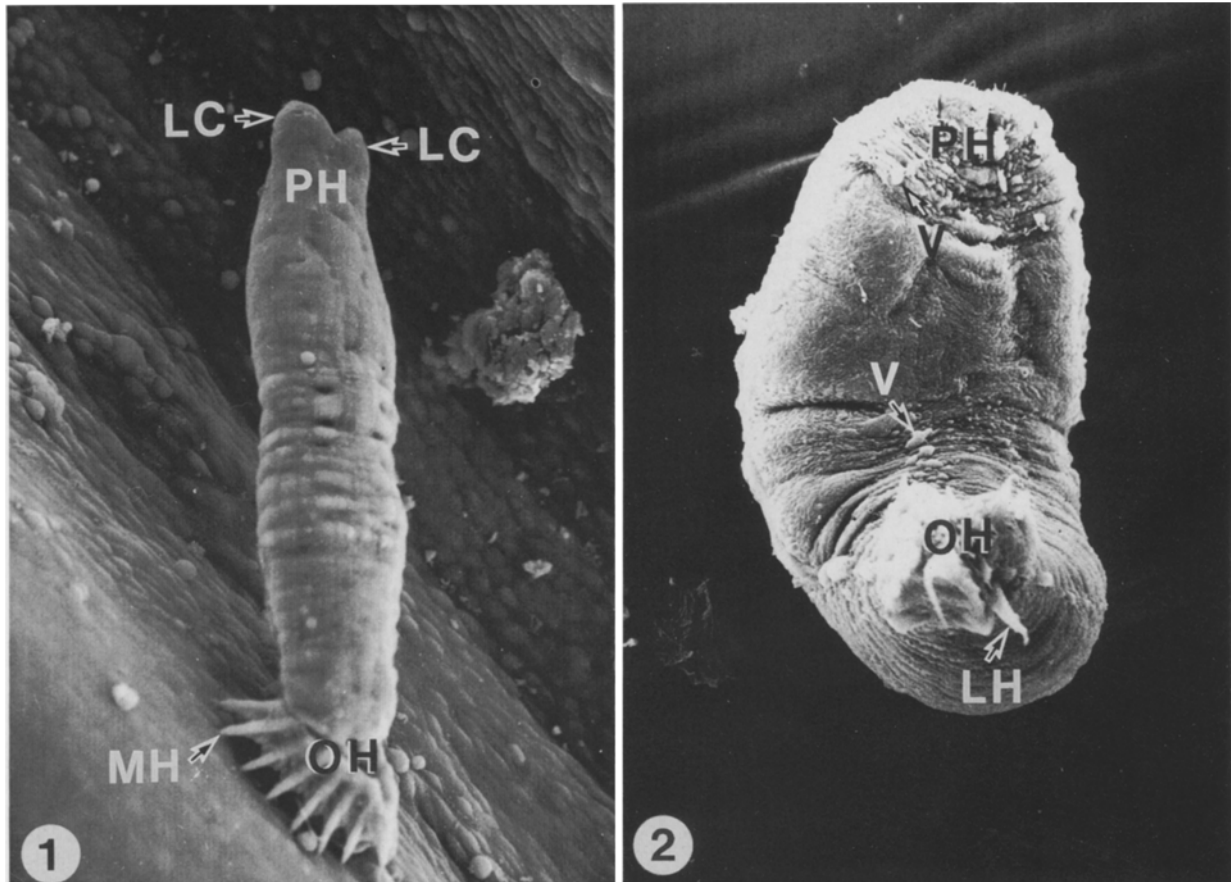
By means of light, scanning (SEM) and transmission electron microscopy (TEM), it was clearly demonstrated that toltrazuril caused damage to

*Dactylogyrus vastator*, *D. extensus*, and *Diplozoon paradoxum* similar to that previously shown for praziquantel treatment (Schmahl and Mehlhorn 1985; Schmahl and Taraschewski 1987). In the three *Dactylogyrus* species, *P. bini*, and *G. arcuatus*, the tegument of the body and peduncle region showed considerable vacuolization (Figs. 1, 2). The vacuoles seemed to originate immediately from the surface membrane. SEM investigations in *D. paradoxum* and *D. homoion* showed pronounced depressions in the tegument and vacuolization in the region close to the sucker. Vacuoles originating from the deep folds of the tegument clearly demonstrated the deleterious effects of toltrazuril on these species.

Small carps (19–31 mm) tolerated treatment with 5 and 10 µg toltrazuril for up to 7 and 4 h, respectively. Treatment with 15 and 20 µg/ml led to a decrease in motility after 1.5 and 1 h, respectively and, in a few cases, the fish swam upside down. These effects were reversible after the fish were placed in fresh water.

Roaches (120–158 mm) and breams (120–145 mm) tolerated treatment with 20 µg/ml for up to 7.5 h at 15° C, and subadult tenches (40–52 mm) tolerated treatment with 20 µg/ml for up to 4 h. European eels (subadult) tolerated the dose effective in eradicating *P. bini* (10 µg/ml, 4 h; 20 µg/ml, 1.5 h) without any problems. Adult eels tolerated 50 µg/ml for up to 12 h, although their epidermis produced more slime. None of the fish species tested showed signs of toxic effects due to toltrazuril treatment, and no alteration in behavior was observed during the 2 weeks following their incubation.

Bathing infected fish in water containing toltrazuril is a new chemotherapeutic treatment for monogenean infestations. Considering that toltrazuril



**Figs. 1, 2.** Scanning electron micrographs of *G. arcuatus*. **Fig. 1.** Nontreated control; specimen attached to a fin of a stickleback.  $\times 490$ . **Fig. 2.** Treated specimen. The parasite was lethally damaged and dropped off its host after incubation in water containing  $20 \mu\text{g}$  toltrazuril/ml for 1 h.  $\times 620$ .

*Abbreviations:* LC, lobe bearing the cephalic glands; LH, large hook; MH, marginal hooklet; OH, opisthaptor; PH, prohaptor; V, vacuole

is also effective against protozoan parasites in fish (Mehlhorn et al. 1988), a new broad-spectrum parasitocidal compound is now available.

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