Hydrobiologia vol. 48, 2, pag. 137-139, 1976

SCANNING MICROSCOPY OF PHARYNGEAL AND ORAL TEETH OF THE TELEOST TILAPIA MOSSAMBICA (PETERS)

W. J. R. LANZING & D. R. HIGGINBOTHAM

School of Biological Sciences, University of Sydney
Electron microscope Unit, University of Sydney, Australia

Received May 13, 1974

Keywords: Tilapia, Denture. Sound production.

Abstract

The pharyngeal and oral teeth of the fish *Tilapia mossambica* (Peters) were examined with a scanning microscope. It appeared that the dorsal pharyngeal teeth form a peculiar hooklike extension at the tip, whereas the ventral pharyngeal teeth tend to curve in a posterior direction. The two lateral flanges at the tip of the ventral teeth are probably the areas of contact with the dorsal teeth when the latter are pressed down during sound production or feeding. However, the oral teeth develop along a different line. Apart from villiform teeth the upper and lower jaws also develop tricuspid and bicuspid oral teeth, with the bicuspids concentrated mainly along the outer edge of the jaw.

Introduction

Recently, it was shown that the pharyngeal teeth of *Tilapia mossambica* were involved in sound production (Lanzing, 1974). The pharyngeal teeth are located in two separate dorsal pharyngeal bones and an unpaired ventral pharyngeal bone. It was noted that the tips of these teeth were not pointed but possessed obliquely cut faces. Further studies using the scanning microscope were undertaken to verify these dental structures and to compare them with the oral teeth located in the jaws of the fish.

Material and methods

The fish under investigation were laboratory-reared *Tilapia mossambica* (Peters). Heads of formalin-fixed specimen were prepared and examined with a scanning

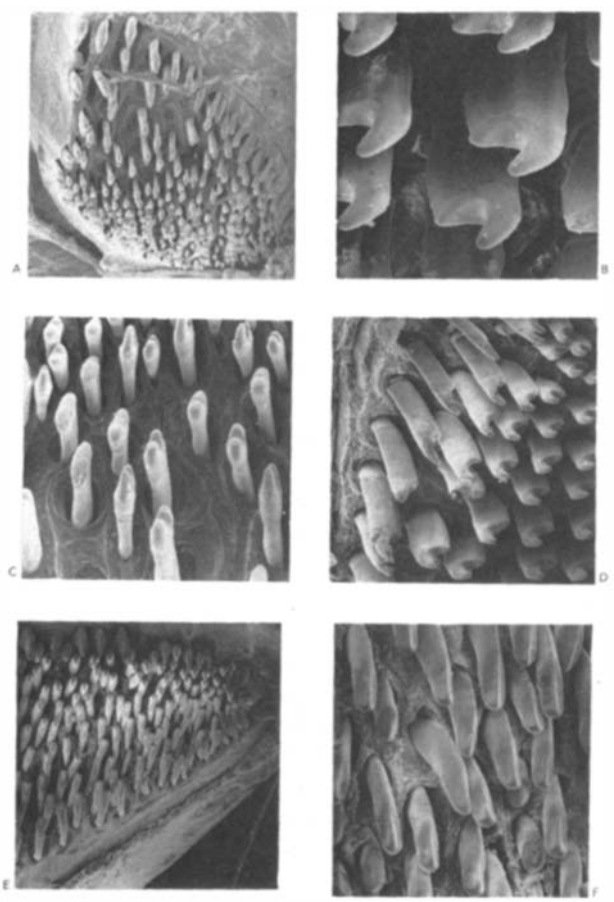

Plate 1. A – one of the dorsal pharyngeals with many teeth protruding from it. 34 x; B – showing hook-like process of the dorsal pharyngeal teeth. 128 x; C – details of the same area shown in A. 42 x; D – view on the rostrolateral side of the dorsal pharyngeal. 68 x; E – view on the rostrolateral side of the ventral pharyngeal. 34 x; F – details of the ventral pharyngeal teeth, showing the central ridge separating two lateral areas. 128 x.

Dr. W. Junk b.v. Publishers - The Hague, The Netherlands

microscope according to procedures outlined previously (Lanzing & Higginbotham, 1974). In addition, jaws of other heads were examined with a dissecting microscope.

Results

As is shown in Plate I, A each dorsal pharyngeal bone is covered by a large number of teeth projecting ventrally into the pharyngeal cavity. Close examination of these teeth reveals that each tooth possesses a somewhat complicated structure at its tip. The tip of each tooth is neither pointed nor flat, but carries a hooklike process with the end of the hook projected posteriorly (Plate I, B and C). The teeth tend to become shorter towards the posterior region of the pharyngeal bone, whereas some of the marginal lateral teeth exhibit a villiform outline (Plate I, D).

On the other hand, the teeth of the ventral pharyngeal bone are formed in a different fashion. Plate I, E and F show that these teeth do not carry hook-like processes. Instead, the distal half of each tooth shows a backward curvature. The upper surface of the curved area is divided into two small sloping faces separated by a central ridge (Plate II, G). The marginal teeth of the ventral pharyngeal bone are less modified, often showing a villiform structure. Despite the various modifications, the distal surfaces of the dorsal and ventral pharyngeal teeth show a parallel orientation with respect to one another and are curved in a posterior direction.

With regard to the oral teeth located on the upper and lower jaws, the photographs reveal that these teeth are not of a uniform type. Plate II, H shows that each jaw may carry at least 3 rows of teeth. The innermost rows include villiform teeth, which do not exhibit any distal modifications. The middle row(s) consist of teeth that possess a striking tricuspidate distal region (Plate II, J and K). The tip of each tooth typically shows two lateral cusps dominated by a slightly taller central cusp.

Finally, the oral teeth of the outer row have a bicuspid appearance, one of the cusps always being much larger than the other (Plate II, I and L). Close examination of the bicuspid teeth reveals that the distal region of the bicuspid is formed in such a way that the cutting edge slopes down towards, respectively, the left- and right-hand side of the jaw (Plate II, H). Consequently, the slope of the edge of the frontal teeth of the jaws on the left-hand side are almost at right angles to those on the right-hand side. However, in the lateral region of the jaws the bicuspids are all placed parallel with the body axis, with the edge of the teeth sloping down caudally.

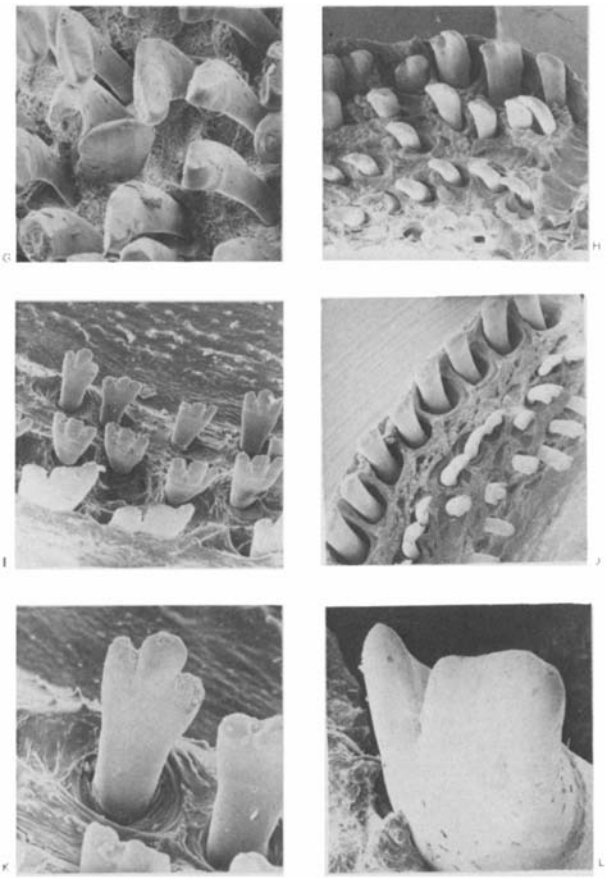

Plate II. G – highly magnified ventral pharyngeal teeth. 170 x; H – view on the frontal region of the lower jaw showing several rows of teeth. 34 x; I – another jaw, clearly showing the bicuspid outermost row of teeth. 68 x; J – showing a number of tricuspidate oral teeth. 34 x; K – tricuspidate tooth enlarged. 212 x; L – bicuspid highly enlarged, showing the unequal nature of the cusps. 340 x.

Removal of the oral epithelium covering the edge of the jaw reveals that growing bicuspids are already recognizable as such before they erupt. In fully developed tricuspids and bicuspids the serrated edge shows a rusty-brown colouration. However, some teeth appear to have lost the cusps with the associated brown-coloured 'cap'; these teeth are no doubt worn-out ones.

A scheme of the various types of teeth in the oral cavity of *Tilapia mossambica* is presented in Figure 1. The possible mutual relationships between these types will be discussed below.

Discussion

Although the presumption that the tips of the dorsal and ventral pharyngeal teeth have obliquely cut but parallel faces (Lanzing, 1974) has essentially been proved correct, some unexpected dental modifications were found during further studies. The unusual 'hook and anvil' arrangement of these teeth could be useful for the production of sound. It is suggested that when the hook of the dorsal teeth touch or scrape over one of the distal faces of the ventral teeth, sounds would be produced that can be picked up by a hydrophone. Since both components of the 'hook and anvil' arrangement are curved in a caudal direction, they would offer little resistance to food particles being passed on to the oesophagus. In fact, Greenwood (1953) in a brief communication already noted that the 'hooked crown' of the upper pharyngeal teeth of *Tilapia esculenta* might rake a mixture of mucus and phytoplankton towards the oesophagus.

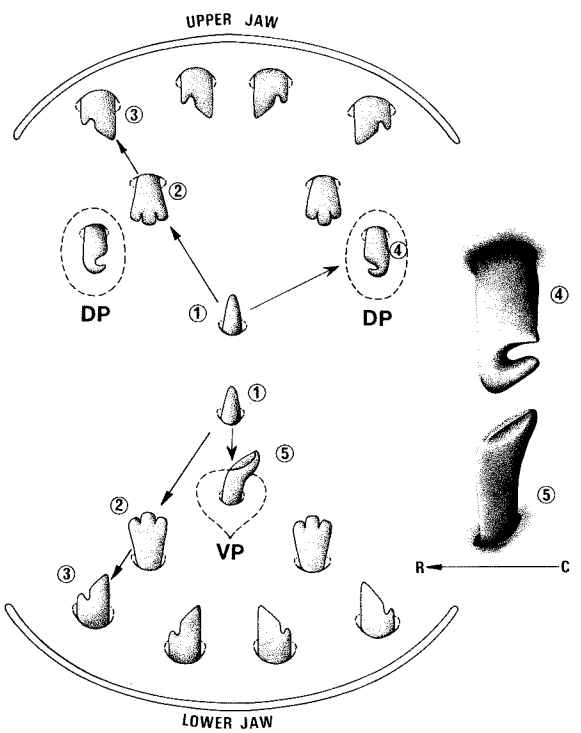

Fig. 1. shows the different types of teeth present in the mouth of *Tilapia mossambica.* Arrows indicate suggested direction of evolution of tooth development. D.P.: dorsal pharyngeal, V.P.: ventral pharyngeal. 1: villiform tooth. 2: tricuspid. 3: bicuspid. 4: upper pharyngeal tooth. 5: lower pharyngeal tooth. Inset: shows the relative position of upper and lower pharyngeal teeth. R: rostrad. C: caudad.

As discussed above, the oral teeth are not always villiform; they may also exhibit a tricuspid or a bicuspid appearance.

The diagram in Fig. 1 suggests how the tricuspids might have evolved from simple villiform teeth. Bicuspids, in turn, might have evolved from tricuspids by uniting two of the three cusps and suppressing the growth of the remaining cusp. Since bicuspids are recognizable prior to eruption, their peculiar form cannot be due to wear and tear of the distal region.

The development of the pharyngeal teeth would follow a slightly different line of development. It is suggested that both dorsal and ventral pharyngeal teeth could evolve from villiform teeth if the latter gradually curve in a caudal direction. Formation of the hook of the dorsal pharyngeal teeth would take place if growth at the tip of the tooth is restricted to the anterior or rostral side only.

Although other species of Tilapia are capable of the production of sound under water (Lanzing, 1974), the pharyngeal teeth are not necessarily identical to those of *Tilapia mossambica.* Jubb (1961) notes, for instance, that the pharyngeal teeth of *T. mossambica* are finer than those of *T. melanopleura,* but coarser than those of *T. macrochir.* Apparently, the form of the pharyngeal teeth is related to the type of food ingested, which may vary from blue-green algae (Fish, 1960) to several species of weed (Lahser, 1967). Presumably, the cutting edge of the mature oral teeth could be used in cutting strands of weed. The brown coloured cap visible at the tip of intact teeth of *Tilapia* also occurs in other fish species. Schmidt (1969) notes that the colour is due to iron oxide associated with the presence of enamel.

References

Fish, G. R. 1960. Comparative activity of digestive enzymes in the alimentary canal of Tilapia and perch. Hydrobiologia 15: 161-178.

Greenwood, P. H. 1953. Feeding mechanism of the cichlid fish Tilapia esculenta Nature 172: 207-208.

Jubb, R. 1961. An illustrated guide to the freshwater fishes of South African rivers. Stuart Manning, Bulawayo, S.A.

Lahser, C. W. 1967. Tilapia mossambica as a fish for aquatic weed control. Progr. Fish Cult. 29: 48-50.

Lanzing, W. J. R. & Higginbotham, D. R. 1974. Scanning microscopy of surface structures of Tilapia mossambica scales. J. Fish Biol. 6: 307-310.

Lanzing, W. J. R. 1974. Sound production in Tilapia mossambica. J. Fish Biol. 6: 341-347.

Schmidt, W. J. 1969. Die Schmelznatur des eisenoxydhaltigen Kappe auf Teleosteir Zähnen. Z. Zellforsch. und Mikrosk. Anat 93: 447-450.