

ON THE PYLORIC CAECA IN FISHES OF THE GENUS SCOMBEROMORUS LACÉPÈDE

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The pyloric caeca of fishes vary considerably in number, shape, size and arrangement, and constitute a characteristic feature of the intestinal tract of a very large number of families, both fresh-water and marine, widely distributed in all parts of the world (Rahimullah, 1945).

In spite of the numerous references in the literature on the pyloric caeca, its function is still discussed, being unknown in many fish species.

In this paper a comparative description is made of the macro and micro morphology of the pyloric caeca of the king mackerel, *Scomberomorus cavalla* (Cuvier), and the Spanish mackerel, *Scomberomorus maculatus* (Mitchill). Enzyme tests were also effected trying to determine its probable function.

MATERIAL AND METHODS

The pyloric caeca of 16 king mackerels and 16 Spanish mackerels were analysed. All specimens were captured off Fortaleza County (Ceará — Brazil), and included individuals of both sexes of the two species.

For macroscopic morphology observation, the pyloric caeca were fresh examined or preserved at 10% formalin.

For histological study, Bouin fluid was used, injected through the inicial part of the intestine, in order to secure a better fixation. Afterwards, they were immersed in the same fluid. Fragments of the inicial and distal parts of the caeca were imbedded in paraffin, and sections (both transverse and longitudinal, 5 micra in thickness) were cut. Sections were

stained in Heidenhain's iron haematoxylin — Eosin or by Mallory — Giemsa method.

For tests of presence or absence of enzymes, the pyloric caeca, stomach and intestine contents of 10 individuals were utilized, separately ground with Glycerol in a mortar, thoroughly washed and sterilized. It was then centrifuged at 3,000 rpm for 15 minutes, and the fluid was drained in equal quantities in two tubes marked A and B. Tube A was put in a water-bath and kept in boiling water for 30 minutes. Tube B contents were submitted to the following tests: demonstration of the presence of diastase, maltase, lypase, pepsin, and trypsin, using the same methods utilized by Rahimullah (1945).

COMPARATIVE MORPHOLOGY

Macroscopic aspects

Spanish mackerel pyloric caeca are very similar to the ones of the king mackerel (Mota Alves & Tomé, 1966; Mota Alves, 1969), differing however in details that will be pointed out during the description.

They are distributed in the initial portion of the intestine, arranged in such a way, as to totally cover it, and be covered in its turn, by the median lobe of the liver.

They are tube shaped, with a diameter of about 3 to 4 mm, and branch from the pyloric bulb into smaller diameter tubes, of about 1 mm, which, are also secondarily divided, ending in a tuft of caeca with an average diameter of 0.5 mm, forming an almost compact mass of numerous diverticula. These do

not communicate directly with the intestine, only their main stems being connected with the pyloric bulb, an enlargement being present in its anterior part.

King mackerel pyloric caeca are slightly bigger and less numerous than those of the Spanish mackerel, presenting a higher level of individualization.

In Spanish mackerel, the whole set of pyloric caeca is covered by a connective membrane there being a strong adherence between it and the intestine, giving a false impression of a single piece. This is not the case in the king mackerel.

Microscopic aspects

Histologically, there are no significant differences between king mackerel and Spanish mackerel pyloric caeca. They are very similar to the intestine, with only minor modifications, such as: thinner walls, higher number of mucous secreting cells, as well as absence of true villi and Lieberkühn crypts.

The caeca wall, as well as that of the intestine, are composed by four layers, from the lumen to the exterior, as follows: mucosa, sub-mucosa, muscular layer and serosa. However, the sub-mucosa layer does not constitute a proper one, being formed by the "tunica propria" of the mucosa (Mota Alves & Tomé, 1966; Mota Alves, 1969).

The mucosa layer is composed of relatively higher folds than the ones found in the intestine, producing a false impression of villi and Lieberkühn crypts. Epithelium is of simple type, composed of tall cells, with basal oval nucleus, intercalated by numerous mucous secreting cells. A regular number of leucocytes is found in the epithelium. Cilia were not found, although registered by some authors for different species.

The mucosa epithelium rests on a layer of areolar connective tissue, where blood vessels and sparse connective fibres are found. In its outermost portion, the fibres become more compact, assuming a somewhat homogenous aspect, forming the mucosa's "tunica propria", that can be confused with the sub-mucosa.

The muscular layer is divided into two other ones: one, with the muscle fibres longitudinally arranged; the other, circularly arranged with transversely disposed fibres. These layers vary in thickness in different regions of the pyloric caeca. In the main stems they are thicker than in the ends of the pyloric caeca. In the king mackerel, the longitudinal muscle layer is reduced to a very thin layer of fibres, and may be absent in certain regions. Where present, it represents about 1/3 of the muscular layer. In the Spanish

mackerel, the two layers are of equivalent thickness.

The serosa layer, in the Spanish mackerel, as well as in the king mackerel, is composed of a single scammous cells layer, typical of the peritonium.

Figure 1 shows the histological aspects presented by the mucosa of king mackerel and Spanish mackerel intestine and pyloric caeca.

DISCUSSION AND CONCLUSIONS

In order to test presence or absence of enzymes, the pyloric caeca were submitted to the tests described by Rahimullah (1945), and the results obtained are presented in table I.

Presence of maltase, lipase and trypsin in the pyloric caeca and intestine of both species was observed, suggesting also a secretory function of the pyloric caeca.

In the king mackerel pepsin found only in the stomach, induce us to believe in a peptic digestion, limited to this organ. Thus, we can suppose that the pyloric caeca act only as intestine auxiliaries.

In the Spanish mackerel, however, pepsin was also found in the pyloric caeca, inducing us to believe that they also take part in the digestion, and permitting the elaboration of two hypothesis: that the produced quantity of this enzyme by the stomach is so high, thus not been totally utilized, so that it partially passes into the intestine and pyloric caeca; that pepsin is synthetized in the pyloric caeca itself. The first hypothesis was discarded, for the pepsin research in the anterior part of the intestine, anterior to the pyloric caeca, presented a negative result. Pepsin would then be synthetized in the pyloric caeca, and these would auxiliate the stomach in its peptic digestion.

Besides enzymes common to the intestine and pyloric caeca, the very similar histological aspect of these two portions of the digestive apparatus, induces us to attribute an intestinal function to the pyloric caeca, although in the Spanish mackerel, through pepsin secretion it may, at least partially, have a similar function to that of the stomach.

However, as the enzyme tests are only qualitative, we do not know wheather or not quantitative analysis would permit other conclusions.

On the other hand, Svetovidov (1934) refers for several species of fishes that include large organisms in their feeding habits, and consequently have a slower digestion, that they have a larger number of pyloric caeca when compared with species that feed upon smaller organisms. This seems also to be true

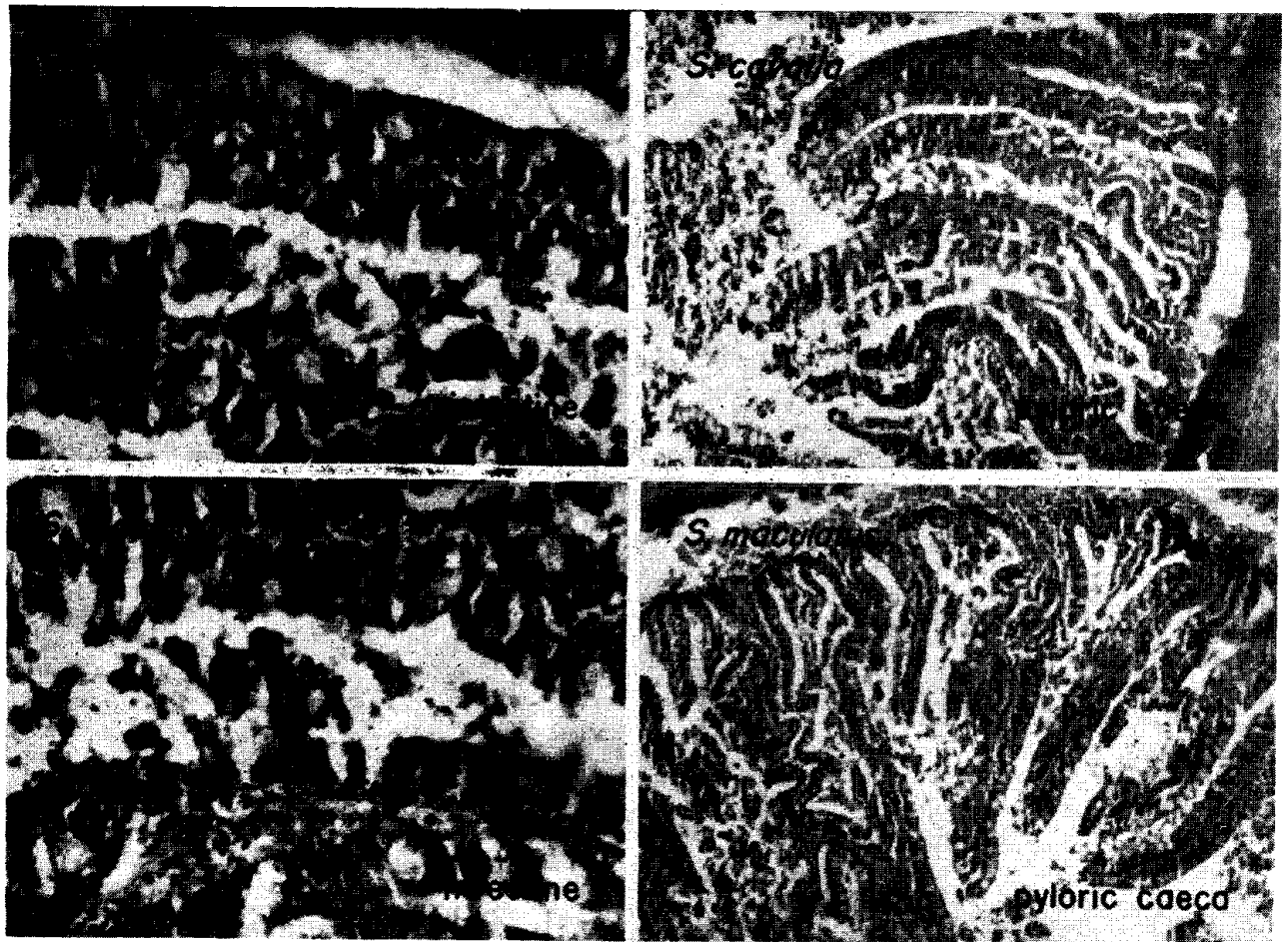


Figure 1 — King mackerel, *Scomberomorus cavalla* (Cuvier), and Spanish mackerel, *Scomberomorus maculatus* (Mitchill), intestine and pyloric caeca.

TABLE I

Enzymes found in the stomach, pyloric caeca and intestine of king mackerel, *Scomberomorus cavalla* (Cuvier), and Spanish mackerel, *Scomberomorus maculatus* (Mitchill).

Species	Organs	Pepsin	Lipase	Maltase	Trypsin	Diastase
king mackerel	stomach	+	—	—	—	—
	pyloric caeca	—	+	+	+	—
	intestine	—	+	+	+	—
Spanish mackerel	stomach	+	—	—	—	—
	pyloric caeca	+	+	+	+	—
	intestine	—	+	+	+	—

for the present species, that feed principally upon fishes of regular size (Menezes, 1969, 1970), and have an elevated number of pyloric caeca.

Thus, highly increasing the area of the feeding tract, for absorption, as well as for secretory or digestive function, the pyloric caeca are quite important, as it is quite clear that they have an active participation in the digestive process.

SUMMARY

In spite of numerous references in the literature on the study of pyloric caeca, its function is still discussed, being unknown in many fish species.

This paper deals with the general anatomy, histology and probable function of the pyloric caeca of the king mackerel, *Scomberomorus cavalla* (Cuvier), and the

Spanish mackerel, *Scomberomorus maculatus* (Mitchill).

The results indicate that histologically there are no significant differences between king mackerel and Spanish mackerel pyloric caeca. They are very similar to the intestine, with only minor modifications such as: thinner walls, higher number of mucous secreting cells, as well as absence of true villi and Lieberkühn cryptes.

Presence of maltase, lipase and trypsin in the pyloric caeca and intestine of both species was observed, suggesting also a secretory function of the pyloric caeca.

In king mackerel, pepsin found only in the stomach, induce us to believe in a peptic digestion limited to this organ. Thus, we can suppose that the pyloric caeca act only as intestine auxiliaries.

In the Spanish mackerel, however, pepsin was also found in the pyloric caeca, suggesting that they also take part in the digestion.

Besides enzymes common to the intestine and pyloric caeca, the very similar histological aspect of these two portions of the digestive apparatus, lead us to attribute an intestinal function of the pyloric caeca, although in the

Spanish mackerel, through pepsin secretion it may, at least partially, have a similar function to that of the stomach.

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