

The Callous Pad of the Pharyngeal Masticatory Apparatus in Indian Carps

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Introduction

It is a well-known fact that the pharyngeal teeth together with the callous (cornified or horny) pad constitute an efficient masticatory apparatus in carps. The subject of pharyngeal teeth has been studied quite extensively both from the taxonomic and evolutionary standpoints but little is known of the structure of callous pad. The literature reveals short accounts in the communications on the alimentary tract of fish by ROGICK (1931), CURRY (1939), AL-HUSSAINI (1949) and GIRGIS (1952).

The purpose of the present study is to extend the range of observations on the callous pad in Indian carps to synthesize the earlier viewpoints. The fishes under report are *Catla catla* (HAM.) and *Barbus stigma* (C. & V.) which were collected from their natural environs and fixed in Bouin's fluid. Material was sectioned 6-8 μ thick and sections were stained with Delafield's haematoxylin and eosin.

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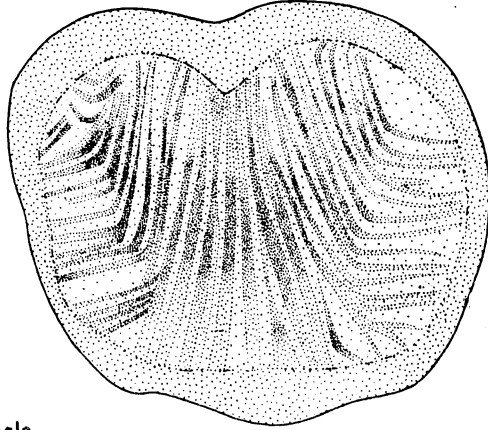
Morphology and histology of the callous pad

Morphology:—The callous pad in *Catla catla* and *Barbus stigma* (Plate I, Figs. a, b) is borne on the masticatory process of the basioccipital bone of the skull. It forms the dorsal surface of the pharyngeal dental apparatus against which the pharyngeal teeth work and crush the food before it enters the oesophagus.

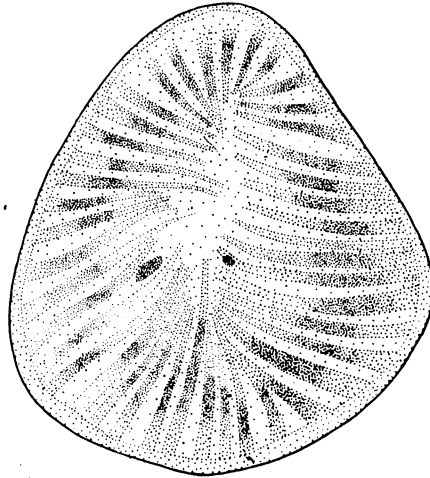
ROGICK (1931) mentions that the posterior pharynx in *Campostoma anomalum* includes the region of the ventral pharyngeal teeth and a dorsal callous pad. CURRY (1939) reports in the carp, *Cyprinus carpio communis* that a small cornified hard triangular structure is found dorsal to the pharyngeal teeth. The base of the triangle is anterior. AL-HUSSAINI (1949) describes that a horny pad is developed in the dorsal wall of the pharynx below the occipital region of the skull opposite to the pharyngeal teeth. In *Rutilus rutilus* this is more or less ovoid in plan; in *Cyprinus carpio* it is similar to that of *Rutilus rutilus* but even harder; and in *Gobio gobio* the pad is trapezoidal in plan, not so well-developed and is much softer. GIRGIS (1952) states

Plate I

Callous pad

*Calla catla*

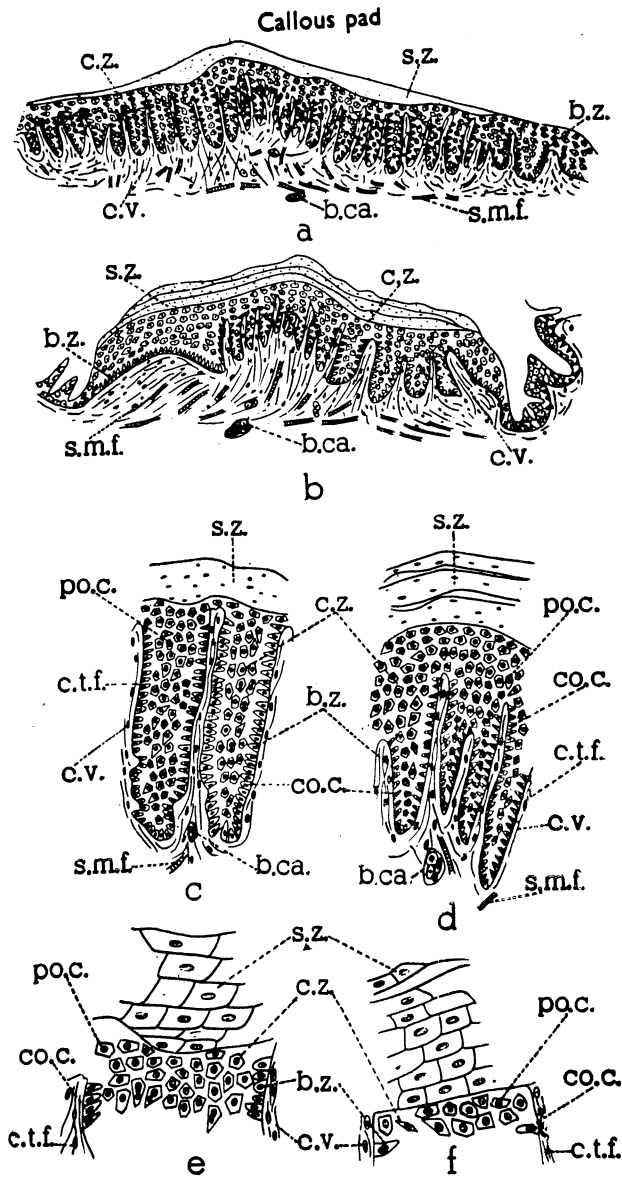
a

*Barbus stigma*

b

Fig. a. Callous pad of *Calla catla*. $\times 40$.Fig. b. Callous pad of *Barbus stigma*. $\times 40$.

Plate II



- Fig. a. A transverse section passing through the callous pad of *Catla catla*. $\times 40$.
 Fig. b. A transverse section passing through the callous pad of *Barbus stigma*. $\times 40$.
 Fig. c. A part of the transverse section passing through the callous pad of *Catla catla*. $\times 120$.
 Fig. d. A part of the transverse section passing through the callous pad of *Barbus stigma*. $\times 120$.
 Fig. e. The different zones of the callous pad of *Catla catla*. $\times 315$.
 Fig. f. The different zones of the callous pad of *Barbus stigma*. $\times 315$.

b.ca., blood capillary; *b.z.*, basal zone; *c.t.f.*, connective tissue fibres; *c.v.*, cutis vera; *c.z.*, central zone; *co.c.*, columnar cell; *po.c.*, polygonal cell; *s.m.f.*, striated muscle fibres; *s.z.*, superficial zone.

that the roof the posterior pharynx is formed of an extremely hard cornified structure which rests on a ventral extension of the basioccipital.

Histology:—Four distinct zones which constitute the callous pad of *Calla calla* are: the superficial zone or the stratum corneum, the central zone or rete mucosum, the basal zone and the supporting zone or cutis vera (Plate II, Figs. a, c, e).

The superficial zone is thick and has very closely-set polygonal cells which give the appearance of strips of cells. The nuclei in these cells are in different states of degeneration and are seen only after a careful focussing of the section. This zone is easily identified owing to its affinity of taking deep eosin stain in contrast with other zones. It has greatest thickness in the middle region and the whole zone assumes an attenuated form. The central zone is bigger than other zones and is recognized by folds which are large in the centre than on the sides. The folds consist of distinct polygonal cells, each with a centrally-situated big round or oval nucleus. Bridges are clearly seen between each cell. Towards the periphery of the folds the cells are of the columnar type and form the basal zone. Cutis vera is the supporting layer of the pad and is composed of irregularly disposed connective tissue fibres which run also in between the folds. Muscle fibres of striated type are present and the zone has an abundant vascular supply.

The callous pad in *Barbus stigma* consists of the same zones as described in *Calla calla* (Plate II, Figs. b, d, f). The superficial zone is an horny layer and is composed of three sheets joined together with some ground substance which takes deep stain with eosin. The sheets have polygonal flat cells, with nuclei in various phases of disintegration and are not sharply differentiated and distinct. The central zone is folded and is packed with polygonal cells. The intercellular clefts or bridges are distinct. The deepest cells, set on the surface of cutis vera, are columnar, forming the basal zone. The cutis vera is a stratum of dense fibrous connective tissue with striated muscle fibres and blood capillaries in it.

Discussion:—ROGICK (1931), in a very concise description (unaccompanied with figure) on the roof of posterior pharynx in *Campostoma anomalum*, mentions an extremely thick layer of desquamating cells on the pad. The cells of the pad are very large, polygonal and show frequent intercellular cytoplasmic bridges. Extremely slender mucosal folds penetrate halfway up the pad. CURRY (1939) describes in the cornified pad of *Cyprinus carpio communis* a layer of cornified cells which are enucleate, a stratum of disintegrating cells, a layer of living cells and the connective tissue folds. The intercellular bridges between large polygonal cells are distinguishable. The epithelial cells next to the connective tissue folds form a single layer of columnar cells resting on a basement membrane. Striated muscle bundles are found at the base of the pad. AL-HUSSAINI (1949) divides the structure of the horny pad of *Cyprinus carpio*, *Rutilus rutilus* and *Gobio gobio* into three zones: the superficial, the middle and the basal. The staining reactions of superficial zone are those characteristic of horn; the cells have thick membranes, irregular outline and the nuclei are retained but in a very degenerate condition and the cells are shed from the surface either singly or in groups. The

middle zone comprises large polygonal cells, with clearly visible fine cytoplasmic bridges. The basal zone consists of a single layer of columnar cells following the sinuosities of the tunica propria. Numerous striated muscle fibres are found at the base of the pad which presumably would be capable of effecting some adjustment of its position. GIRGIS (1952) states that the epithelium of the pad of *Labeo horie* is composed of distinct zones which react differently to stains. The superficial zone (stratum corneum) contains cells with very irregular outline, some cells contain disintegrating nuclei while others are enucleate. Apparently cornification of the pad serves to produce the solid surface necessary for mastication. At or near the surface layer the degree of disintegration of nucleus varies in each cell. Protoplasmic bridges between large polygonal cells are distinguishable and some cells exhibit mitotic figures. The basal layer is made up of large columnar cells, which rest on a basement membrane, lined by the areolar connective tissue papillae.

Considering the histological details given above it is evident that observations on the callous pad of *Catla catla* and *Barbus stigma* are in harmony with those of AL-HUSSAINI (1949). It may be epitomized that, in the callous pad, the nuclei in the cells of the superficial zone are found in a very degenerate condition; large polygonal cells (a few with mitotic stages) of the middle zone have fine bridges and the basal zone is of columnar cells. Striated muscle fibres occur in the cutis vera. In *Labeo horie* (GIRGIS, 1952) the cells with disintegrating nuclei are observed among completely cornified enucleate cells all over the pad. In this it differs from *Cyprinus carpio communis* (CURRY, 1939) where the nucleated cells form the bottom layers of stratum corneum and the enucleate cells form the top layers but it is in accordance with the observations made by AL-HUSSAINI (1949) on the horny pad of carps. Desquamation of cells takes place at the surface.

AL-HUSSAINI (1949) has remarked on the basis of an histological examination of the horny pad of the mirror carp, *Cyprinus carpio* (herbivorous), the roach, *Rutilus rutilus* (omnivorous) and the gudgeon, *Gobio gobio* (carnivorous) that the hardness of the pad is in direct proportion to the thickness of superficial zone, being greatest in the herbivorous and least in the carnivorous fish. The author adheres to an opinion that an elaborate study on the structure of callous pad in carps with different food and feeding habits is essential before deducing any inference.

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