HISTOLOGICAL STUDY OF THE PHARYNGEAL PAD OF THE AFRICAN CATFISH (*Clarias gariepinus* BURCHELL 1822)

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ABSTRACT

The pharyngeal pad located dorsally on the oro-pharynx was processed for light microscopy. The epithelium was of stratified mucous type containing taste buds, club cells and teeth. The micromorphology revealed the co-localization of teeth and taste bud. Developing, erupting and erupted teeth were also seen. The thin bone of cancellous type with a marrow seen provided point of origin and insertion for the skeletal muscle present. Osteoblasts were seen on the surface of the cancellous bone probably depositing bone matrix. The pad had a base of hyaline cartilage. Stratum adiposum was observed and may be site for nutrient storage and also function in reducing friction between sliding muscle fibres since it was sandwiched between muscle fibres. The micromorphology suggest an organ used in trituration and selection of food by gustation. The blood vessels in the bone marrow suggest haematopoietic function. The bone and cartilage present is for support.

Keywords: Pharyngeal pad, Histology, Food selection, Taste bud, African catfish

INTRODUCTION

The teleost digestive tract is simple comprising bucco-pharyngeal cavity, oesophagus, stomach, intestine and anus (Diaz *et al*., 2008; Raji and Norouzi, 2010). These organs are involved in the breakdown of ingested food macromolecules into small absorbable macromolecules. These small molecules are necessary for the maintenance, growth and energy needs of the body (Johnson, 1994; Junqueira and Carneiro, 2005). The bucco-pharynx is the region that collects food from the environment. It bears a variety of specialized organs for specific functions. The organs include: lamella organ, buccal values, tongue, pharyngeal pads and epibranchial organ (Girgis, 1952; Kapoor, 1957; Khanna, 1959; Schmitz and Baker, 1969).

The pharyngeal pads located on both sides of the pharynx dorsally are round, flattened interiorly and sunken interposteriarily. It has a small pharyngeal teeth and taste buds on the entire surface. It is supported by thin bony care of cylindrical bones (Venkateswarlu, 1962; Kawamoto and Higashi, 1965). Taste buds in all vertebrates including teleosts are for gustation (Roper, 1989; Reutter and Witt, 1993). The excitation of the taste bud in bucco-pharynx has seen associated with food swallowing (Atema, 1971). Pharyngeal teeth in some teleosts are used for food processing which involves mastication and crushing before transporting to the esophagus for deglutition (Sibbing, 1982; Claes and De Vree, 1991; Vandewalle *et al.*, 1994, 1995). The pharyngeal pad as an organ serves in food trituration or act as an effective filter or food selector by gustation in some teleost (Ezeasor, 1982; Linber *et al.*, 1998).

In this study, microanatomy of the pharyngeal pad in the domesticated African catfish was investigated since there is no information in available literature on its micromorphology. The result will provide baseline information and the functional significance of the organ is discussed.

MATERIALS AND METHODS

Fifteen adult African catfish (weighed 900 ± 56g and standard body length of 45 ± 5 cm) sourced from commercial fish farms in Umudike, Abia State, Nigeria were used for the study. The fish were immobilized by stunning. The oro-pharyngeal cavity was cut open through the membrane between the upper and lower jaws, and the pharyngeal pad dissected out. The pharyngeal pad was seen as mound rounded solid mass attached dorsally on the oro-pharyngeal wall very close to oesophageal inlet (Figure 1). It was excised, decalcified according to Gooding and Stewart (1932), before subjecting to routine histological procedure of dehydration in graded ethanol, clearing in xylene and embedding in paraffin wax. Sections 5µm thick were obtained with Leitz microtome model 1512. General tissue morphology was observed after haematoxlin and eosin (H&E) staining.

RESULTS

The epithelia were of stratified squamous containing mucous cells and taste buds (Figure 2). Club cells were seen but interspersed in between the epithelia. Pharyngeal teeth were seen erupting, erupted and some developing as tooth bud beside developed tooth (Figure 3). The teeth that were caudally pointing were attached to the cancellous bone by collagenous fibres in regular direction. Blood vessels were seen in the bone marrow. The skeletal muscle was seen originating from the connective tissue near the bone (Figure 3). Adipose tissues were present between the skeletal muscle bundles (Figure 3). Beneath the epithelia was a thick layer of collagenous fibres. The cancellous bone had marrow in between the species. Osteoblasts were seen at the surface of the bone (Figure 4). The presence of hyaline cartilage was observed at the base with thick collagen bundle surrounding it (the perichondrium). Regions of appositional growth were seen. The hyaline cartilage had chondrocytes in groups surrounded by homogenous matrix.

DISCUSSION

After the ingestion of food, it is processed and modified by mastication, crushing, or tearing prior to swallowing (Vandewalle *et al.*, 1995). Revelation by this microanatomy indicates the involvement of this organ – pharyngeal pad in this food processing. The epithelia of stratified squamous type are for protection of underlying tissue (Tamarkin, 2011). The presence of mucous cells indicates production of mucin for lubrication of the organ against mechanical abrasion since the teleost digestive tract lacks salivary gland (Elbal and Agulleiro, 1986; Micale and Mughia, 2011).

The co-localization of the taste buds and teeth on the pharynx of fish have been reported in several literatures (Reutter *et al.*, 1974; Ezeasor, 1982; Sibbing, 1982; Hobbler and Merchant, 1983; Northcott and Beveridge, 1988). This has been associated with ingestion or rejection of potential food item by gustation prior to swallowing (Linser *et al.*, 1998). Majority of taste buds observed are of type II since their receptor areas are located beneath the elevated epithelia papillae, but type III were also present since they have their apices slightly above the surface of corresponding epithelia (Reutter *et al.*, 1974).

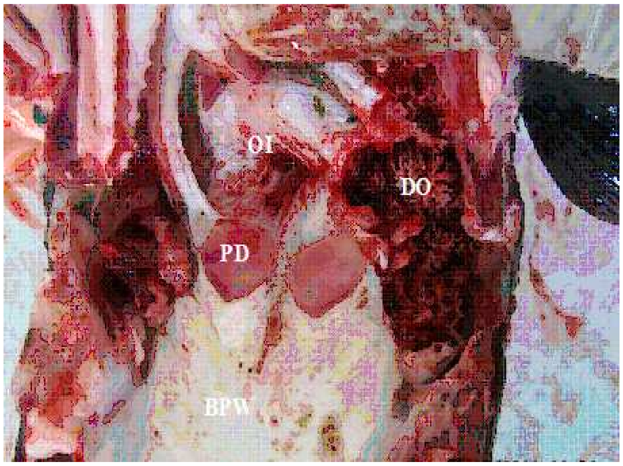

Figure 1: Topographic dissected section of adult maxillary part of buco-pharengeal cavity showing aditus oesophagus (OE),dendritic organ (DO), pharyngeal pad (PD), upper buco-pharyngeal wall (BPW). (H & E X 400)

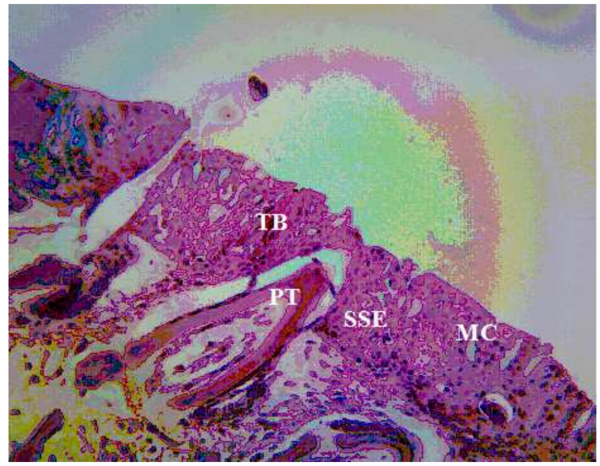

Figure 2: Adult pharyngeal pad showing taste bud (TB), pharyngeal pad tooth (PT), stratified squamous epithelia (SSE), mucous cell (MC). (H & E X 400)

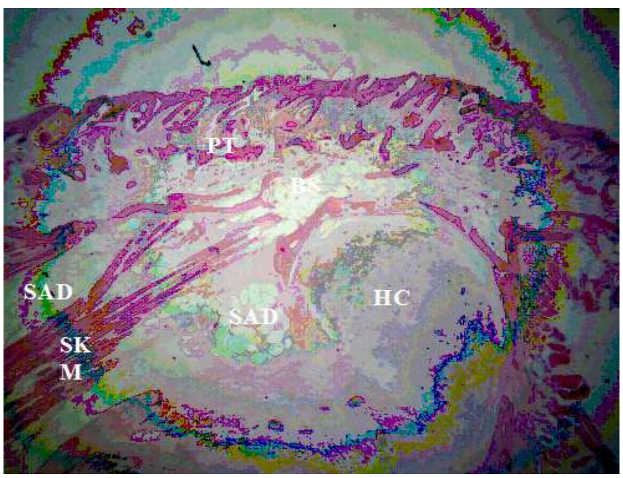

Figure 3: Section of adult pharyngeal pad showing pharyngeal tooth (PT), bone spicles (BS), skeletal muscle (SKM), Stratum Adiposum (SAD), hyaline cartilage, (HC). (H & E X 100)

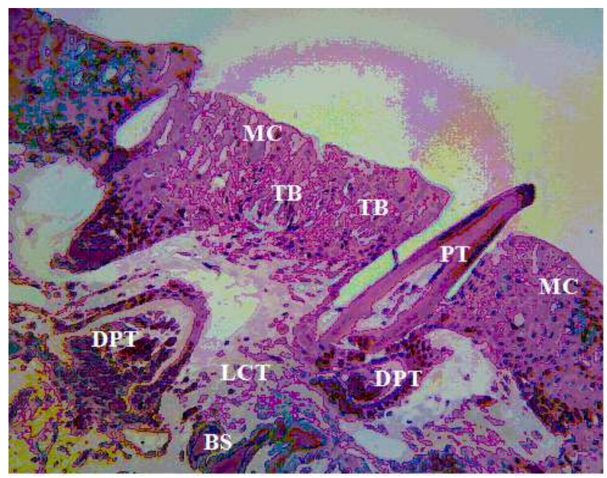

Figure 4: Section of adult pharyngeal pad showing taste bus (TB), mucous cell (MC), tooth (PT), developing tooth (DPT), bone spicles (BS) containing osteoblasts. Note loose connective tissue (LCT). (H & E X 400)

Type I taste buds were seen with prominently elevated receptor area above the epithelia (Ezeasor, 1982). The caudally pointing teeth may probably be used in crushing and directing the food towards the oesophagus. The presence of developing tooth bud beside each pharyngeal tooth and several unerupted teeth beneath the epithelium suggest that in the pharyngeal pad there is great turnover of teeth due to loss by mechanical action of regular crushing. It is also possible that the periodontal ligament is not firm enough to hold them in place for a long time, or the tooth which is of homodont dentition, is continually replaced, hence polyphydontia (Goth, 2009; John and Lisa, 2010).

The bone spicles with osteoblast present suggest a developing bore with continuous lay of bone matrix by the osteoblast (Baron, 2008;

Mellors, 2011). The presence of blood vessels in the bone marrow suggest haematopoietic function, or source of nourishment to this connective region. The bone which is of cancellous type may be providing point of origin and attachment for the skeletal muscle present. The skeletal muscle seen may probably be involved in voluntary regurgitation or selection of food (Al-Hussaini and Kholy, 1953; Barrington, 1957). The thick collagen fibre seen may be for support and strengthening of the epithelia. The stratum adiposum (Guerra *et al*., 2006) seen suggest metabolite storage, reducing frictional effect of the sliding and contracting skeletal muscle since it is present in-between the striated muscle layers and the bony core. The cartilaginous mass present is of hyaline type with homogeneous matrix and chondrocytes in lacunae. The presence of dividing chronblast in the perichondricum suggests appositional growth. This cartilaginous mass is for support (Lehner *et al*., 1989).

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