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The jaws of the domesticated fingerling African Catfish (*Clarias Gariepinus*, Burchell 1822): A morpho-functional study

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ABSTRACT

The jaw micro-architecture of the fingerling African catfish from commercial domesticated pond was investigated to fill the gap from available literature. This becomes important as the animals' jaw is a predilection site for pollutants, thus employed in lesion diagnosis. The fish jaws were fixed in 10% neutral buffered formalin and subjected to routine histological procedure of dehydration in graded ethanol, clearing in xylene and embedding in paraffin wax. Sections were stained for light microscopy. The mound shaped upper lip that projected rostrally was a bilamina membranous tissue containing sandwiched loose irregular tissues. The epidermal epithelium was of stratified squamous cells containing melanophores. The dermis contained loose irregular connective tissues. Internal surface of the upper jaw was lined by stratified squamous epithelium eosinophillic club cells. Skeletal muscles originating from the teeth alveoli were invested considerably into the lips and ventral border of the sandwiched loose connective tissue. Caudal to the lips internally was the dental papilla containing conical caniform teeth rostrally and molariform teeth caudally. Dorsocaudal to the dental region, were bars of elastic cartilage surrounded by perichondrium. Ventral to these cartilage bars and caudal to the dental region was a thick layer of dense regular connective tissue. In the lower jaw, some epithelial eosinophilic club cells presented a halo round the centrally placed nucleus.

Key words: Club cells, melanophores, elastic cartilage, teeth, histology, Nigeria.

INTRODUCTION

The roof of the buccal cavity is formed by the upper jaw, velum and the palate; the floor is formed by the lower jaw and the tongue, while the rostral border is formed by the lips, the oesophageal in-let marks the caudal extremity [1, 2]. The buccal cavity of fish plays an important role in the capture and selection of food and rejection of undesirable items ingested by fish. The lips of fish and its associated structures may participate with selection, deglutition and predigestive preparation of food [3, 4, 5].

As part of our continued study on the morpho-functional biology of the farmed African catfish, we focused in this paper on the micromorphology of the fingerling jaws as this is important to commercial feed formulators in adapting feed constituents especially as it relates to jaw size and expansivity. Also it will enrich our understanding of fish jaw anatomy at this age as there are reports of age related jaw teeth changes in the Mekong giant catfish, *Pangasianodon gigas* [6]. Clinicians will find this study of immense value since we have documentation of jaw deformation in some fish like the Salmons [7]; in the mink, jaw histopathological lesions have become the most sensitive indicator of exposure to persistent organic pollutants [8], hence the need to establish its normal histology.

MATERIALS AND METHODS

Seven fingerling African catfish sourced from a commercial aquaculture in Eastern Nigeria were used for the study. They weighed an average of 1.5 g with a mettler balance (Model Ohaus scout PRO-200) with a sensitivity of 0.1 g and measured a standard body length of 4.8 cm with a metre rule. The fish were humanely immobilized by chloroform euthanasia. Thereafter, they were decapitated and a mid sagittal incision of the entire head, extending from the lower jaw, to the upper jaw, through to the skull, was made with a scalpel blade. The entire head containing this section was fixed in 10% neutral buffered formalin and subjected to routine histological procedure of dehydration in graded ethanol, clearing in xylene and embedding in paraffin wax [9]. Sections (5µm thick) were obtained with Leitz microtome model 1512. They were stained with haematoxylin and eosin for light microscopic examination [9]. Photomicrographs were taken with Motican 2001 camera (Motican UK) attached to Olympus microscope model CX22.

RESULTS AND DISCUSSION

Upper Jaw: the lip was a bilamina membranous tissue containing sandwiched loose irregular tissues. This outline of the lip mucosal fold was mound shaped. The lip appeared like a projected tissue, rostrally (fig.1). The epidermal epithelium was of stratified squamous cells containing melanophores and melanocytes (fig.1). The dermis contained loose irregular connective tissues. Skeletal muscles originating from the teeth alveoli were invested considerably into the lips and ventral border of the sandwiched loose connective tissue. These skeletal fibres were abundantly vascularised. The external surface of the jaw caudal to the lips was lined by stratified squamous epithelium. The dermal region comprised of dense regular connective tissue. Internal surface was lined by stratified squamous epithelium eosinophillic club cells (Fig. 2). Caudal to the lips internally was the dental papilla containing caniform teeth rostrally and molariform teeth caudally (Fig 1). Some teeth alveoli contained developing tooth, while erupting teeth were seen below the epithelium. Dorsocaudal to the dental region, were bars of elastic cartilage surrounded by perichondrium. Also elastic cartilage layer joined two linear plates of hyaline cartilage at their poles, and the cartilages were covered by a common perichondrium (Fig 3). Skeletal muscles were seen attaching to these hyaline cartilages (fig 4). Ventral to these cartilage bars and caudal to the dental region was thick layer of dense regular connective tissue.

Lower jaw: The microarchitecture of the lower jaw presented similar histology to the upper jaw but slight differences were observed. Some epithelial eosinophilic club cells presented a halo round the centrally placed nucleus. The dental papilla contained only caniform teeth (fig.5). Also the lower jaw contained rectangular to polyhedrally shaped hyaline cartilage in addition to the elastic cartilage in the middle region caudal to the dental papilla. Some plates of hyaline cartilage were joined together by layer of elastic cartilage. Blood vessels were abundant in the core of the jaws.

The bilaminar membranous nature of the lip will protect the inner structures especially during prey capture being an omnivorous fish with higher need for animal content [10, 11]. The projected lip will significantly aid in mouth protrusion and suction. Evidence of teleost jaw protrusion has been reported in the Neotropical Cichlids [12] and the broomtail wrasse, *Cheilinus lunulatus* [13]. The stratified epithelium protects the lip as the primary organ of prehension [14]; while the epithelial melanocytes are responsible for the dark colouration the jaw [15]. The presence of eosinophilic club cells contradicts an earlier study where the club cells were absent on the oropharngeal cavity (OC) [16]. This sharp difference may be breed related or that club cells develop with age as was evidenced by the presence of nuclear halo in the reported club cells. These type of club cells maybe immature cells. Club cells are associated with flight and fight response in fish; also they have reported to have pathogen protective function by their ability to express haemoagglutinin [17, 18].

The skeletal muscle fibres will voluntarily control the jaw movement especially the prehension function of the lips. The abundant blood vessels signify an active organ, hence the need for regular and good metabolite transport [19]. The dense regular connective tissue will compliment the actions of the skeletal muscles in the mechanism of food capture and processing in the OC. The caniform teeth will be involved in tearing for food and prey capture while the molariform teeth will crush and grind the food. The presence of teeth in the teleost jaw have been reported the largemouth Bass, *Microptensus salmoides* [20]; *Prochilodus lineatus* [21]; *Rita rita* [22]. The developing tooth will replace weak and worn out tooth in this species under study but in the Mekong giant catfish, *Pangasianodon gigas*

the tooth replacement ability has been reported to be limited to fingerlings and juveniles only [6], but in the adult African catfish, Ikpegbu et al.,[23], has established that tooth replacement in the OC is continuous.

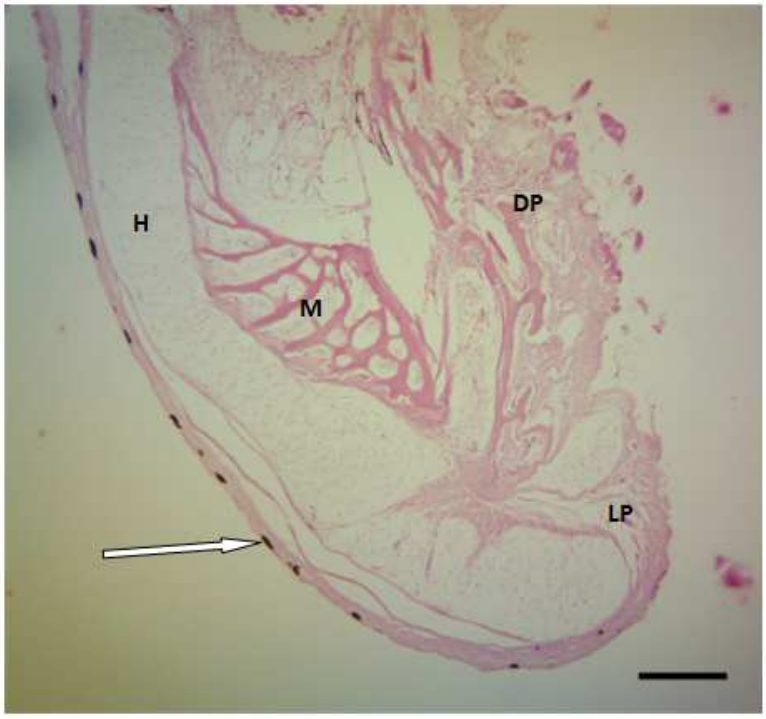

Fig. 1. Section of fingerling upper jaw showing dental papilla DP, maxilla M, dorsal hyaline cartilage H, lip LP, and melanocyte (White arrow). H & E. (Scale bar = 10µm)

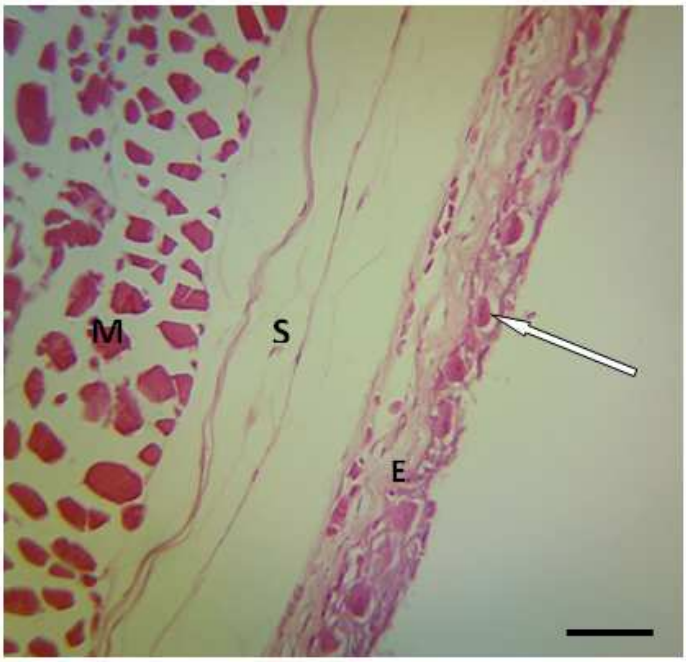

Fig. 2. Section of the roof of the oral pharyngeal cavity showing stratified epithelium E, containing eosinophilic club cell (white arrow), submucosa S, and tunica muscularis of skeletal muscle M. H&E. (Scale bar = 10µm).

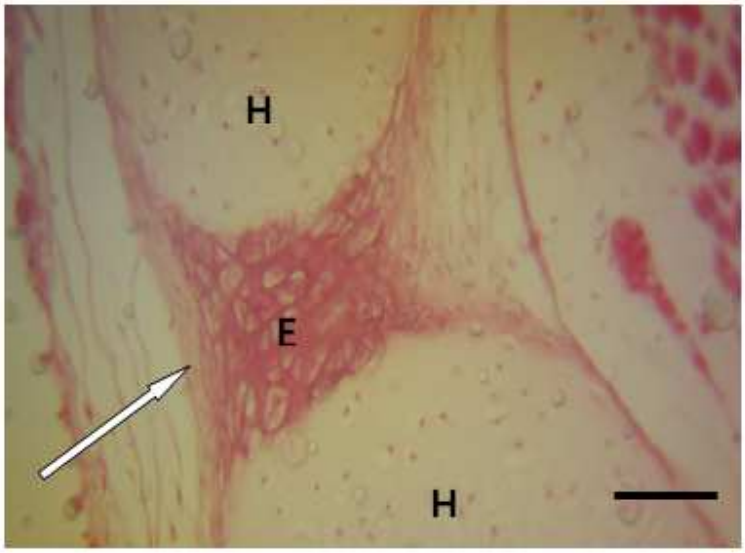

Fig. 3. Section of upper jaw showing elastic cartilage E, in-between two plates of hyaline cartilage H. Note that a common perichondrium (white arrow) covered the entire catilages H&E. (Scale bar = 10µm).

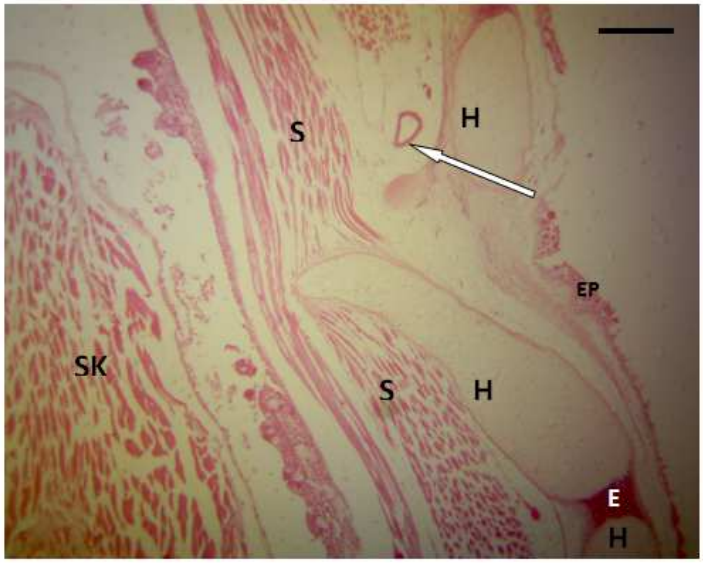

Fig. 4. Section of upper jaw showing epithelium EP; hyaline cartilage H, attached to another cartilage by elastic cartilage E; blood vessel (white arrow); and skeletal muscle SK, in the tunica muscularis. Note the skeletal muscle fibres S,originating and attaching to the hyaline cartilage. H & E. (Scale bar = 10µm).

The presence of hyaline cartilage as seen here has been reported in the jaws of other teleosts. The elastic cartilage serving as joint capsule between two plates of hyaline cartilage will increase the flexibility of the jaws, thus increasing the capacity of the fingerling jaw to accommodate more food. This is very important in the restricted concrete tanks environment where food is highly competed for. The adjustable OC volume capacity will enable the fingerling temporarily store food in the OC during their regimented feeding.

In conclusion, this paper presents the normal histomorphology of the fingering OC especially as it relates to adaptive feeding mechanism. It will help nutritionist in feed pellet size and aquaculture managers to reduce stocking density, as the food temporarily stored in the OC may be lost during grinding or deglutition. To researchers it is a baseline

study for further investigative research especially the prey capture mechanism in this species and clinicians in fish jaw disease diagnosis.

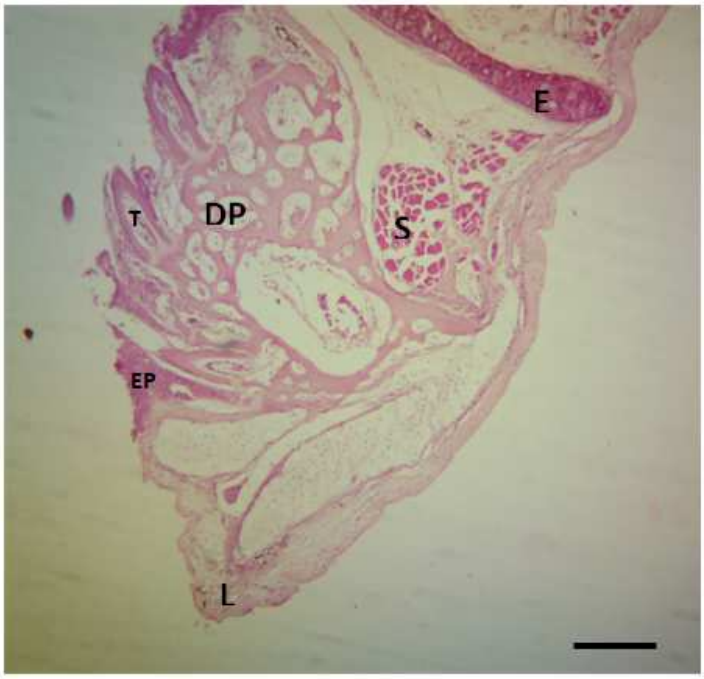

Fig.5. Section Lower jaw showing elastic cartilage E, skeletal muscle S, epithelium EP and the lip L. Note the dental papilla DP, containing caniform tooth T. H&E. (Scale bar = 10µm).

REFERENCES

[1] N.E.R. El Bakary, *Asian Pac. J. Trop. Biomed*. **2014**, 4, 13-17.
[2] E. Ikpegbu, U.C. Nlebedum, O. Nnadozie, I.O. Agbakwuru. *Kenya Vet*., **2014**, 38, 1-10.
[3] J.M. Icardo, W.P.Wong, E. Colvee, F. Garofalo, A.M. Loong, *J. Morphol*. **2011**, 272, 769-779.
[4] B. Canan, W.S. Nascimento, N.B. Silva, S. Chellappa. *Sci. World. J*. **2012**; doi: 10.1100/2012/787316.
[5] S. Erdogan, A. Alan. *Microsc. Res. Tech*. **2012**, 75, 379-387.
[6] Y. Kakizawa, W. Meenakarn, *J. Oral Sci*., **2003**, 45, 213-221.
[7] V. Felipe, M. Enrique, F. Pablo, R. Mariana, *Int. J. Morphol*., **2003**, 21, 211-219.
[8] J.M. Haynes, S.T. Wellman, J.J. Pagano. **2007**. NY Depart. Environ. Conser, Buffalo, NY.
[9] J.D. Bancroft, A. Stevens, Churchill Livingstone, London, **1990**, 88-89 pp.
[10] J.C. Micha, Paris, France, **1973**, pp: 110.
[11] C.O. Emokaro, P.A. Ekunme, A. Achille, *Res. J. Agric. Biol. Sci.* **2010**, **6**, 215 – 219.
[12] T.B. Waltzek, P.C. Wainwright, *J. Morphol*. **2003**, 257, 96–106.
[13] H.M.M. Khalaf–Allah, *Egypt. J. Aquat. Biol. Fish*., **2013**,17, 123-141.
[14] N. Agrawal, A.K. Mittal, *Jap. J Ichthyol*, **1991**, 37, 363-373.
[15] A.M.D. Hussain, A.A. Rana, D.N. Gazwa, *J. Madent Alelem Col*, **2009**, 1,1-17.
[16] E. Ikpegbu, D.N. Ezeasor, U.C. Nlebedum, C. Nwogu, O. Nnadozie, I.O. Agbakwuru, *Bull. Ani. Health Prod*. Africa, **2012a**, **60**: 533- 541
[17] A.O. Diaz, A.H. Escalante, A.M. Garcia, A.L. Goldemberg, *Anat. Histol. Embryol*.**2006**, **35**, 42 – 46.
[18] J.X. Cao, W.M. Wang, *Anat. Histol. Embryol*. **2009**, **38**, 254 – 261.
[19] I. Singh, Jaypee Brothers Medical Publishers (P) Ltd. **2006**, P. 179.
[20] P.J. Linser, W.E.S. Carr, H.S. Cate, C.D. Derby, J.C. Nethertion III, *Biol. Bull*. **1998**, **195**, 273 – 281.
[21] R. Fugi, A.A. Agostinho, N.S. Hahn, *Rev. Brasil. Biol*., **2001**, 61, 27-33.
[22] M. Yashpal, U. Kumari, S. Mittal, A.K. Mittal. *Belg. J. Zool*., **2006**, 136, 155-162.
[23] E. Ikpegbu, D.N. Ezeasor, U.C. Nlebedum, C. Nwogu, O. Nnadozie, I.O. Agbakwuru, I. O. Ani. *Res. Internat*., **2012b**, 9, 1613 – 1618.