HISTOLOGICAL OBSERVATIONS ON THE DENDRETIC ORGAN OF THE FARMED ADULT AFRICAN CATFISH (*CLARIAS GARIEPINUS*) FROM EASTERN NIGERIA

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Abstract: The histology of the accessory respiratory organ of the African catfish – dendretic organ was investigated to reveal its microanatomy. The data obtained will provide baseline data for further investigative research and assist fish pathologists. The histology showed that the tubular shaped dendretic organ was covered by stratified squamous epithelium containing periodic acid-Schiff (PAS) and alcian blue (AB) positive mucous cells. On most surfaces, the epithelial cells were organized into columns with mucous cells placed in-between the epithelial cell columns. At the tip of the surface, capillaries were lined by endothelium at the surface epithelium/air contact area. The subepithelial layer was of loose connective tissue containing adipose tissue and occasional blood vessels. The core of the dendretic organ contained elastic cartilage surrounded by a dense layer of perichondrium. Elastic fibres were observed the territorial and inter-territorial spaces.

Key words: mucous cells, histochemistry, surface capillaries, epithelium.

Introduction

The gill is the main organ for gas exchange in fish (Ahmed et al., 2008). This mechanism is achieved through the exchange of gasses between dissolved air in water and the vascular mesh of the gills. In the Indian subcontinent, fish species with highly vascularised skin has been associated with the exploitation of dissolved air in water (Devi and Banerjee, 2007). In some Teleosts, the amphibious fish, some organs have become modified for atmospheric gas exchange. These organs are referred to as air breathing organs (ABOs) (Devi and Banerjee, 2007). ABOs are also referred to as accessory respiratory organs and they include: the modified gill structures of the suprabranchial chamber of the *Channa striata*, dendretic organ of sharptooth catfish from the Nile River, skin of *Alticus kirkii* and *Periophthalmus*

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magnuspinnatus, plicated labyrinthine organs of Anabas testudineus, swim bladder in Bowfin Amia calva, the rich vascularized lips of Piaractus nigripinnis, and intestinal air breathing of loach Lepidocephalichthys guntea (Bransons and Hake, 1972; Munshi et al., 1986; Moitra et al., 1989; Gervais and Tufts, 1998; Park, 2002; Ahmed et al., 2008; Ahmed and Mekkawy, 2011).

The development of these ABOs has been associated with the amphibious feature of utilizing both aquatic and terrestrial habitat (Gordon et al., 1969). Generally, amphibious behavior is related with a reduction in water quality or quantity and/or biotic factors like fights, cannibalism and predation (Sayer and Davenport, 1991; Martin, 1995; Taylor, 2000). Hence, within the science of vertebrate evolution, amphibious fishes represent one of the intermediate stages between the aquatic life and terrestrial habitation (Sayer, 2005).

Owing to the importance of respiration for tissue metabolic activities (Maina, 2002), a number of studies are published in order to describe morphology of ABOs. These include using them as bio-markers for heavy metal contamination in waters, provision of normal histomorphology to aid investigative researches (Munshi et al., 1986; Banerjee and Chandra, 2005; Devi and Banerjee, 2007).

Despite the increasing importance of African catfish as a cultivable species of choice in most commercial aquaculture in Nigeria, there is a dearth of information from available literature on the microanatomy of this ABO – the dendretic organ. The data obtained from fish from a commercial farm will provide baseline data for further investigative research and aid clinicians in disease diagnosis.

**Material and Methods**

Seven adult African catfish from a commercial aquaculture farm with concrete tanks in Eastern Nigeria were used for the study. They weighed 900, 850, 950, 880, 930, 890 and 900 g and a standard body length was measured and it amounted to 45, 48, 42, 40, 50, 44 and 46 cm. The fish were immobilized and the oro-pharyngeal cavity was cut open through the membrane between the upper and lower jaws, and the specimen was dissected out. The specimen under study – dendretic organ, was seen as an outgrowth on the dorsal aspect of the gills and it was excised and subjected to routine histological procedure of dehydration in graded ethanol, clearing in xylene and embedding in paraffin wax.

Sections 5 µm thick were obtained with Leitz microtome model 1512. They were stained with haematoxylin and eosin for light microscopy examination (Bancroft and Stevens, 1990). Photomicrographs were taken with Motican 2001 camera (Motican, UK) attached to an Olympus microscope.
Results and Discussion

The tubular shaped dendritic organ was covered by stratified squamous epithelium containing mucous cells (Figures 1–2). On most surfaces, the epithelial epithelium was organized into columns with mucous cells placed in-between the epithelial cell columns (Figure 3). At the tip of the surface, capillaries were lined by endothelium at the surface epithelium/air contact area (Figures 2–3). The subepithelial layer was of loose connective tissue containing adipose tissue and occasional blood vessels. The core of the dendritic organ contained elastic cartilage surrounded by a dense layer of perichondrium (Figure 2). Elastic fibres were observed in the territorial and inter-territorial spaces. Mucin histochemistry revealed that the mucous cells contained both PAS and AB positive mucin.
The stratified squamous epithelium protects the underlying structures (Agrawal and Mittal, 1991). It also supports the surface capillaries involved in gas exchange with atmospheric air. The epithelium stacked in columns with mucous cells positioned in-between the columns may be an adaptation that will make the produced mucin easily cleanse the respiratory epithelium. This column-shaped epithelium will also allow more vascularization, since each individual column contained capillaries at the tip of the organ/air interphase. This increases surface area for gas exchange. The mucin, produced by the mucous cells, reduces mechanical abrasion, thus protecting the respiratory epithelium (Elbal and Agulleiro, 1986; Moitra et al., 1989; Ghosh et al., 2011), while acid mucin will protect the respiratory epithelium against pathogens (Neuhaus et al., 2007). It will also trap moisture at the respiratory epithelial surface, enhancing the rate of gas exchange (Singh et al., 1974; Moitra et al., 1989).

Figure 2. Section of the dendritic organ showing surface capillaries (arrow), mucous cells (M), epithelial cells (E), blood vessel (BV), in the loose connective tissue (L). Note the elastic cartilaginous core (C) surrounded by fibrous perichondrium (P).
The simple endothelial lined capillary is thin enough to allow a rapid exchange of gas between blood in the capillaries and atmospheric air (Ahmed and Mekkawy, 2011). Thus the air/blood barrier is basically the simple endothelium and its basement membrane. This finding is consistent with the reports on other ABOs (Munshi et al., 1986; Maina, 2002). The blood vessels in the subepithelial region are the arteries that send branches to form the surface capillaries involved in gas exchange. The elastic cartilage allows support and flexibility of the dendritic organ as it has been previously reported in literature (Ahmed et al., 2008).

Figure 3. Section of dendritic organ showing columnar shaped epithelium containing surface capillaries (arrow) at the tip and mucous cells (M) in-between the columns. Note the elastic cartilage (C).
Conclusion

In conclusion, microanatomy of the dendritic organ from commercial aquaculture reveals its adaptation to the exchange of gas from the atmospheric air. This organ will help the fish adapt better in periods of overstocking or dissolved oxygen deficiency in the concrete tanks. This finding will enhance our knowledge on farmed African catfish physiology, help clinicians in disease diagnosis and form the baseline data for further investigative research.

References

Histological observations on the dendritic organ of the African catfish


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HISTOLOŠKA GRAĐA DENDRITSKOG ORGANA GAJENOG ODRASLOG AFRICKOG SOMA (*Clarias gariepinus* B.) IZ ISTOČNE NIGERIJE

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**R e z i m e**


**Ključne reči:** sluzne celije, histohemija, površinski kapilari, epitel.

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