

Body Armours in Amazonian Fish

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Abstract : Most fish are covered by a protective external armour. The characteristics of these armours depend on the individual elements that form them, such as scales, scutes or dermal plates. In this work, we assess the properties of two different types of protective elements: scales from *A. gigas* and dermal plates from *P. pardalis*. *A. Gigas* and *P. Pardalis* are two Amazonian fish with a rather prehistoric aspect. They have large scales and dermal plates that form two different types of protective body armours. Although both scales and dermal plates are formed by collagen and hydroxyapatite, their structures display remarkable differences. The structure and composition of the samples were assessed by means of X-ray diffraction (XRD), Fourier Transform Infrared spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC). Morphology studies were carried out using a Scanning Electron Microscopy (SEM). Nanoindentation tests were performed to measure the reduced moduli in *A. gigas* scales and *P. pardalis* plates. The similarities and differences between scales and dermal plates are discussed based on the experimental results. Both protective armours are designed to be lightweight, flexible and tough. *A. Gigas* scales are light laminated composites, while *P. pardalis* dermal plates show a sandwich like structure with dense outer layers and a porous inner matrix. It seems that the armour of *P. pardalis* is more suited for a bottom-dwelling fish and allows for protection against predators. The scales from *A. Gigas* are more adapted to give protection to a swimming fish. The information obtained from these studies is also important for the development of bioinspired nanocomposites, with potential applications in the biomedical field.

Keywords : *pterygoplichthys pardalis*, dermal plates *arapaima gigas*, fish scales

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