Evolutionary and structural aspects of fish myoglobins

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Myoglobin (Mb) is a hemoprotein contained at high concentrations in skeletal and cardiac muscles of vertebrates. Mb molecule consists of seven to eight α-helical segments, and a heme portion located in a hydrophobic heme pocket. Mb plays an important role as an oxygen reservoir not only in muscle but also in non-muscle tissues. Nearly 30,000 fish species are distributed on the earth, under various environments in temperature, depth, salinity, etc. As far as fish Mbs are concerned, they are especially distributed in muscles, particularly in slow skeletal (dark) and cardiac muscles While scombroid species are rich in Mb even in their fast skeletal muscle ideal for fast cruising, some Antarctic species lack Mb. Because of the tremendous species numbers, characterization of fish Mbs remained unknown in detail. In the present study, amino acid sequences of Mbs from more than 30 fish species were phylogenetically analyzed, and their evolutionary and structural aspects were examined. The results obtained showed that most fish Mbs followed morphological classification, though several unique amino acid substitutions which seem to be the results of environmental and ecological adaptations. Substitutions to reduce the structural rigidity were considered to facilitate oxygen transfer under aquatic environment, sacrificing the molecular stability.