Fish of the Abyss: Adaptation to Protein Structure in Response to High Hydrostatic Pressure

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TOPIC AND ABSTRACT

Many species of fish thrive in hydrostatic pressures that far exceed atmospheric pressure. The purpose of this research is to reveal how abyssal fish have adapted to survive hydrostatic pressures high enough to kill human beings.

Experiments conducted by Takami Morita reveal that certain types of muscle protein, which exists in most vertebrates, have a distinctively altered structure in abyssal fish of the genus Coryphaenoides. The altered structure of these proteins aids significantly in the functioning of these proteins under high pressure.

It is hypothesized that abyssal fish in general have evolved to adapt to the advanced hydrostatic pressures of the abyssal zone through similar protein alteration.

LITERATURE REVIEW

• Cells in abyssal fish are responsible to build, or polymerize, proteins. Polymerization requires a certain amount of volume in a cell. Since volume is inversely related to pressure, pressure has a direct effect on protein polymerization (Morita 28060). In the deepest parts of the ocean, where pressure is high, cells have little volume in which to polymerize proteins. This is one reason why most organisms cannot survive at these pressures (Bartlett 1).

• Takami Morita extracted α-actin protein from two species of abyssal fish, Coryphaenoides armatus and Coryphaenoides yaquinae, commonly named rattails (Morita 28060). α-actin is a component of microfilament system, and appears in the muscle cells of most animals. Morita compared the α-actin of abyssal rattails with the α-actin of other various species: carp, chickens, and non-abyssal rattails (Morita 28060).

• Morita conducted an experiment in which muscle enzymes and cDNA from his multiple species were induced to polymerize α-actin under various pressures (Morita 28061). With increasing pressure, the chicken, carp, and non-abyssal rattail enzymes produced α-actin in increasingly lower volumes, and their efficiency in protein production dropped. Abyssal rattail enzymes continued to polymerize α-actin at a constant efficiency despite high pressure and low volume.

• Morita found that in abyssal rattails, an α-actin protein has three unusual amino acid substitutions which are not present in chicken, carp, or even non-abyssal strains of rattails (Morita 28061). He also found that the altered structure of α-actin in abyssal rattails was instrumental in the protein’s polymerization under immense hydrostatic pressure (Morita 93).

REFERENCES


Photographs:
http://amazingdata.com/terrifying-deep-water-fish/
http://squid.tepapa.govt.nz/the-deep/article/bioluminescence-in-the-deep-ocean

RESEARCH METHODS

• Conclusions are drawn deductively from articles which provide experimental evidence of advantageous protein structure in abyssal fish.

• Resources include the Science and Technology Library, Department of Biological Sciences faculty, and referenced material.

• Further research will go toward a greater understanding of protein structure, and acquisition of additional examples of protein adaptation in multiple species of abyssal fish.

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