

GEPHE SUMMARY

Gephebase Gene
AFGP multigene - antifreeze glycoproteins

Entry Status
Published

GepheID
GP0000052

Main curator
Martin

PHENOTYPIC CHANGE

Trait Category
Physiology

Trait
Anti-freezing

Trait State in Taxon A
Other fishes

Trait State in Taxon B
Dissostichus mawsoni - notothenioid fishes

Ancestral State
Data not curated

Taxonomic Status
Intergeneric or Higher

Taxon A

Latin Name
Teleostei

Common Name
teleost fishes

Synonyms
teleost fishes

Rank
infraclass

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia;
Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii;
Actinopteri; Neopterygii

Parent
Neopterygii () - (Rank: subclass)

NCBI Taxonomy ID
32443

is Taxon A an Intraspecies?
No

Taxon B

Latin Name
Dissostichus mawsoni

Common Name
Antarctic toothfish

Synonyms
Antarctic toothfish; Dissostichus mawsoni Norman, 1937; Dissostichus mawsonii; Dissosticus
mawsoni

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia;
Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii;
Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupecocephala; Euteleostomorpha;
Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorpha; Euacanthomorpha;
Percomorpha; Eupercaria; Perciformes; Notothenioidei; Nototheniidae; Dissostichus

Parent
Dissostichus () - (Rank: genus)

NCBI Taxonomy ID
36200

is Taxon B an Intraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
afgp8

Synonyms
-

String
-

Sequence Similarities
-

GO - Molecular Function
-

GO - Biological Process
-

GO - Cellular Component
GO:0005576 : extracellular region

Presumptive Null
No

UniProtKB Notothenia neglecta
P24856

GenebankID or UniProtKB

Molecular Type

Coding

Aberration Type

Unknown

Molecular Details of the Mutation

multiple modifications of a pancreatic; secreted trypsinogen; notably via multiplications of small tri-peptidic repeats

Experimental Evidence

Candidate Gene

Main Reference

Evolution of antifreeze glycoprotein gene from a trypsinogen gene in Antarctic notothenioid fish. (1997)

Authors

Chen L; DeVries AL; Cheng CH

Abstract

Freezing avoidance conferred by different types of antifreeze proteins in various polar and subpolar fishes represents a remarkable example of cold adaptation, but how these unique proteins arose is unknown. We have found that the antifreeze glycoproteins (AFGPs) of the predominant Antarctic fish taxon, the notothenioids, evolved from a pancreatic trypsinogen. We have determined the likely evolutionary process by which this occurred through characterization and analyses of notothenioid AFGP and trypsinogen genes. The primordial AFGP gene apparently arose through recruitment of the 5' and 3' ends of an ancestral trypsinogen gene, which provided the secretory signal and the 3' untranslated region, respectively, plus de novo amplification of a 9-nt Thr-Ala-Ala coding element from the trypsinogen progenitor to create a new protein coding region for the repetitive tripeptide backbone of the antifreeze protein. The small sequence divergence (4-7%) between notothenioid AFGP and trypsinogen genes indicates that the transformation of the proteinase gene into the novel ice-binding protein gene occurred quite recently, about 5-14 million years ago (mya), which is highly consistent with the estimated times of the freezing of the Antarctic Ocean at 10-14 mya, and of the main phyletic divergence of the AFGP-bearing notothenioid families at 7-15 mya. The notothenioid trypsinogen to AFGP conversion is the first clear example of how an old protein gene spawned a new gene for an entirely new protein with a new function. It also represents a rare instance in which protein evolution, organismal adaptation, and environmental conditions can be linked directly.

Additional References

Nonhepatic origin of notothenioid antifreeze reveals pancreatic synthesis as common mechanism in polar fish freezing avoidance. (2006)

Ancient climate change, antifreeze, and the evolutionary diversification of Antarctic fishes. (2012)

RELATED GEPHE

Related Genes

1 (PEPT1)

Related Haplotypes

No matches found.

COMMENTS