GEPHE SUMMARY

Gephebase Gene

AFGP multigene - antifreeze glycoproteins (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^AFGP multigene - antifreeze glycoproteins^#gephebase-summary-title)

Entry Status

Published

GepheID

GP00000052

Main curator

Martin

PHENOTYPIC CHANGE

Trait Category

Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait

Anti-freezing (https://www.gephebase.org/search-criteria?/and+Trait=^Anti-freezing^#gephebase-summary-title)

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 (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intergeneric or Higher^#gephebase-summary-title)

Taxon A

Latin Name

Teleostei (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Teleostei^#gephebase-summary-title)

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) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 41665)

NCBI Taxonomy ID

32443 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32443)

is Taxon A an Infraspecies?

No

Taxon B

Latin Name

Dissostichus mawsoni (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Dissostichus mawsoni^#gephebase-summary-title)

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; Clupeocephala; Euteleosteomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Euacanthomorphacea; Percomorphaceae; Eupercaria; Perciformes; Notothenioidei; Nototheniidae; Dissostichus

Parent

Dissostichus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 36199)

NCBI Taxonomy ID

36200 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 36200)

is Taxon B an Infraspecies?

No

GENOTYPIC CHANGE

Generic Gene Name

afgp8

Synonyms

-

String

-

Sequence Similarities

-

GO - Molecular Function

-

GO - Biological Process

-

GO - Cellular Component

GO:0005576 : extracellular region (https://www.ebi.ac.uk/QuickGO/term/GO:0005576)

UniProtKB Notothenia neglecta

P24856 (http://www.uniprot.org/uniprot/P24856)

GenebankID or UniProtKB

()

Presumptive Null

No (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title)

Molecular Type

Coding (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title)

Aberration Type

Unknown (https://www.gephebase.org/search-criteria?/and+Aberration Type=^Unknown^#gephebase-summary-title)

Molecular Details of the Mutation

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

Experimental Evidence

Candidate Gene (https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title)

Main Reference

Evolution of antifreeze glycoprotein gene from a trypsinogen gene in Antarctic notothenioid fish. (1997) (https://pubmed.ncbi.nlm.nih.gov/9108060)

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) (https://pubmed.ncbi.nlm.nih.gov/16798878)
Ancient climate change, antifreeze, and the evolutionary diversification of Antarctic fishes. (2012) (https://pubmed.ncbi.nlm.nih.gov/22331888)

RELATED GEPHE

Related Genes

1 (PEPT1) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^32443^/and+Trait=Anti-freezing/or+Taxon ID=^36200^/and+Trait=Anti-freezing/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS