GEPHE SUMMARY

Gephebase Gene
PEPT1 (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^PEPT1^#gephebase-summary-title)

GepheID
GP00000858

Entry Status
Published

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
Chionodraco hamatus

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

Common Name
Antarctic icefish

Synonyms
Chaenichthys rhinoceratus hamatus; Antarctic icefish; Chaenichthys rhinoceratus hamatus Lonnberg, 1905; Chionodraco hamatus (Lonnberg, 1905)

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; Channichthyidae; Chionodraco

Parent
Chionodraco () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 34788)

NCBI Taxonomy ID
36188 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 36188)

is Taxon B an Infraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
slc15a1

Synonyms
-

String
-

Sequence Similarities
Belongs to the PTR2/POT transporter (TC 2.A.17) family.

GO - Molecular Function
GO:0022857 : transmembrane transporter activity (https://www.ebi.ac.uk/QuickGO/term/GO:0022857)

GO - Biological Process
GO:0006857 : oligopeptide transport (https://www.ebi.ac.uk/QuickGO/term/GO:0006857)

GO - Cellular Component

UniProtKB Chionodraco hamatus
Q804I3 (http://www.uniprot.org/uniprot/Q804I3)

GenebankID or UniProtKB
AY170828 (https://www.ncbi.nlm.nih.gov/nuccore/AY170828)

GO:0016021 : integral component of membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0016021)

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

C-terminal (cytosolic) de novo VDMSRKS domain conferring cold resistance

Experimental Evidence

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

Main Reference

Protein cold adaptation strategy via a unique seven-amino acid domain in the icefish (Chionodraco hamatus) PEPT1 transporter. (2013) (https://pubmed.ncbi.nlm.nih.gov/23569229)

Authors

Rizzello A; Romano A; Kottra G; Acierno R; Storelli C; Verri T; Daniel H; Maffia M

Abstract

Adaptation of organisms to extreme environments requires proteins to work at thermodynamically unfavorable conditions. To adapt to subzero temperatures, proteins increase the flexibility of parts of, or even the whole, 3D structure to compensate for the lower thermal kinetic energy available at low temperatures. This may be achieved through single-site amino acid substitutions in regions of the protein that undergo large movements during the catalytic cycle, such as in enzymes or transporter proteins. Other strategies of cold adaptation involving changes in the primary amino acid sequence have not been documented yet. In Antarctic icefish (Chionodraco hamatus) peptide transporter 1 (PEPT1), the first transporter cloned from a vertebrate living at subzero temperatures, we came upon a unique principle of cold adaptation. A de novo domain composed of one to six repeats of seven amino acids (VDMSRKS), placed as an extra stretch in the cytosolic COOH-terminal region, contributed per se to cold adaptation. VDMSRKS was in a protein region uninvolved in transport activity and, notably, when transferred to the COOH terminus of a warm-adapted (rabbit) PEPT1, it conferred cold adaptation to the receiving protein. Overall, we provide a paradigm for protein cold adaptation that relies on insertion of a unique domain that confers greater affinity and maximal transport rates at low temperatures. Due to its ability to transfer a thermal trait, the VDMSRKS domain represents a useful tool for future cell biology or biotechnological applications.

Additional References

RELATED GEPHE

Related Genes

1 (AFGP multigene - antifreeze glycoproteins) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^32443^/and+Trait=Anti-freezing/or+Taxon ID=^36188^/and+Trait=Anti-freezing/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS