GEPHE SUMMARY

Gephebase Gene
pepsinogen A1

GephelD
GP00001917

Entry Status
Published

Main curator
Courtier

PHENOTYPIC CHANGE

Trait Category
Physiology

Trait
Digestion (absence of stomach)

Trait State in Taxon A
presence of stomach and gastric acid production

Trait State in Taxon B
loss of stomach and no gastric acid production

Ancestral State
Taxon A

Taxonomic Status
Intergeneric or Higher

Taxon A #1

Latin Name
Gadus morhua

Common Name
Atlantic cod

Synonyms
Atlantic cod; Gadus morhua Linnaeus, 1758

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; Paracanthomorphacea; Zeiogadaria; Gadariae; Gadiformes; Gadoidei; Gadidae; Gadus

Parent
Gadus () - (Rank: genus)

NCBI Taxonomy ID
8049

is Taxon A an Infraspecies?
No

Taxon B

Latin Name
Danio rerio

Common Name
zebrafish

Synonyms
Brachydanio rerio; Brachydanio rerio frankei; Cyprinus rerio; Danio frankei; Danio rerio frankei; zebrafish; leopard danio; zebra danio; zebra fish; Cyprinus rerio Hamilton, 1822; Danio rerio (Hamilton, 1822); Brachidanio rerio

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupeocephala; Otomorpha; Ostariophysi; Otophysi; Cypriniphysae; Cypriniformes; Cyprinoidei; Cyprinidae; Danio

Parent
Danio () - (Rank: genus)

NCBI Taxonomy ID
7955

is Taxon B an Infraspecies?
No

Taxon A #2

Latin Name
Gasterosteus aculeatus

Common Name
three-spined stickleback

Synonyms
three-spined stickleback; three spined stickleback; Gasterosteus aculeatus Linnaeus, 1758

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; Cottioidei; Gasterosteales; Gasterosteidae; Gasterosteus

Parent
Gasterosteus () - (Rank: genus)

NCBI Taxonomy ID
69293

is Taxon A an Infraspecies?
No

Taxon A #3

Latin Name
Oreochromis niloticus

Common Name
Nile tilapia

Synonyms
Oreochromis nilotica; Tilapia nilotica; Nile tilapia; Oreochromis niloticus (Linnaeus, 1758)

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; Ovalentaria; Cichlomorphae; Cichliformes; Cichlidae; African cichlids; Pseudocrenilabrinae; Oreochromini; Oreochromis

Parent
Oreochromis () - (Rank: genus)

NCBI Taxonomy ID
8128

is Taxon A an Infraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
PGA4

Synonyms
-

String
9606.ENSP00000367391

Sequence Similarities
Belongs to the peptidase A1 family.

GO - Molecular Function
GO:0004190 : aspartic-type endopeptidase activity

GO - Biological Process
GO:0006508 : proteolysis
GO:0044267 : cellular protein metabolic process
GO:0007586 : digestion
GO:0030163 : protein catabolic process

GO - Cellular Component
GO:0070062 : extracellular exosome
GO:0097486 : multivesicular body lumen

Presumptive Null
Yes

Molecular Type
Gene Loss

Aberration Type
Deletion

Deletion Size
-

Molecular Details of the Mutation
Absence of the gene in the genome sequence - high synteny

Experimental Evidence
Candidate Gene

Main Reference
Recurrent gene loss correlates with the evolution of stomach phenotypes in gnathostome history. (2014)

Authors
Castro LF; GonÃ§alves O; Mazan S; Tay BH; Venkatesh B; Wilson JM

UniProtKB Homo sapiens
P0DJD7

GenebankID or UniProtKB

Abstract

The stomach, a hallmark of gnathostome evolution, represents a unique anatomical innovation characterized by the presence of acid- and pepsin-secreting glands. However, the occurrence of these glands in gnathostome species is not universal; in the nineteenth century the French zoologist Cuvier first noted that some teleosts lacked a stomach. Strikingly, Holocephali (chimaeras), dipnoids (lungfish) and monotremes (egg-laying mammals) also lack acid secretion and a gastric cellular phenotype. Here, we test the hypothesis that loss of the gastric phenotype is correlated with the loss of key gastric genes. We investigated species from all the main gnathostome lineages and show the specific contribution of gene loss to the widespread distribution of the agastric condition. We establish that the stomach loss correlates with the persistent and complete absence of the gastric function gene kit--H(+)/K(+)-ATPase (Atp4A and Atp4B) and pepsinogens (Pga, Pgc, Cym)--in the analysed species. We also find that in gastric species the pepsinogen gene complement varies significantly (e.g. two to four in teleosts and tens in some mammals) with multiple events of pseudogenization identified in various lineages. We propose that relaxation of purifying selection in pepsinogen genes and possibly proton pump genes in response to dietary changes led to the numerous independent events of stomach loss in gnathostome history. Significantly, the absence of the gastric genes predicts that reinvention of the stomach in agastric lineages would be highly improbable, in line with Dollo's principle.

Additional References

RELATED GEPHE

Related Genes

4 (ATP4A, ATP4B, pepsinogen A2, pepsinogen A3)

Related Haplotypes

No matches found.

COMMENTS

There are three pepsinogen A genes in teleost fishes - their nomenclature and phylogenetic relationships are different from Mammals pepsinogen genes