

GEPHE SUMMARY

pepsinogen A1 (https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=^pepsinogen+A1^#gephebase-summary-title)	Gephebase Gene	GP00001917	GepheID
Published	Entry Status	Courtier	Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category=^Physiology^#gephebase-summary-title)	Trait Category
Digestion (absence of stomach) (https://www.gephebase.org/search-criteria?/and+Trait=^Digestion+absence+of+stomach^#gephebase-summary-title)	Trait
presence of stomach and gastric acid production	Trait State in Taxon A
loss of stomach and no gastric acid production	Trait State in Taxon B
	Ancestral State
Taxon A	Taxonomic Status
Intergeneric or Higher (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=^Intergeneric+or+Higher^#gephebase-summary-title)	

Taxon A #1	Latin Name
Gadus morhua (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Gadus+morhua^#gephebase-summary-title)	
Atlantic cod	Common Name
Atlantic cod; Gadus morhua Linnaeus, 1758	Synonyms
species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupecocephala; Euteleostomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Paracanthomorphacea; Zeiogadaria; Gadariae; Gadiformes; Gadoidei; Gadidae; Gadus	Lineage
Gadus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8048)	Parent
8049 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8049)	NCBI Taxonomy ID
No	is Taxon A an Intraspecies?

Taxon B	Latin Name
Danio rerio (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Danio+rerio^#gephebase-summary-title)	
zebrafish	Common Name
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	Synonyms
species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupecocephala; Otomorpha; Ostariophysii; Otophysi; Cypriniphysae; Cypriniformes; Cyprinoidei; Cyprinidae; Danio	Lineage
Danio () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7954)	Parent
7955 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7955)	NCBI Taxonomy ID
No	is Taxon B an Intraspecies?

Taxon A #2	Latin Name
Gasterosteus aculeatus (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Gasterosteus+aculeatus^#gephebase-summary-title)	
three-spined stickleback	Common Name
three-spined stickleback; three spined stickleback; Gasterosteus aculeatus Linnaeus, 1758	Synonyms
species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Actinopterygii; Actinopteri; Neopterygii; Teleostei; Osteoglossocephalai; Clupecocephala; Euteleostomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Euacanthomorphacea; Percomorphaeae; Eupercaria; Perciformes; Cottioidi; Gasterosteales;	Lineage

Gasterosteidae; Gasterosteus
 Parent
 Gasterosteus () - (Rank: genus)
 (<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=69292>)
 NCBI Taxonomy ID
 69293
 (<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=69293>)
 is Taxon A an Intraspecies?
 No

Taxon A #3
 Latin Name
 Oreochromis niloticus
 (<https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=~Oreochromis niloticus~#gephebase-summary-title>)
 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; Clupecocephala; Euteleostomorpha; Neoteleostei; Eurypterygia; Ctenosquamata; Acanthomorphata; Euacanthomorphacea; Percormorphaceae; Ovalentaria; Cichlomorphae; Cichliformes; Cichlidae; African cichlids; Pseudocrenilabrinae; Oreochromini; Oreochromis
 Parent
 Oreochromis () - (Rank: genus)
 (<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8139>)
 NCBI Taxonomy ID
 8128
 (<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8128>)
 is Taxon A an Intraspecies?
 No

GENOTYPIC CHANGE

PGA4	Generic Gene Name	P0DJD7 (http://www.uniprot.org/uniprot/P0DJD7)	UniProtKB Homo sapiens
-	Synonyms	0	GenebankID or UniProtKB
9606.ENSPO0000367391 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSPO0000367391)	String		
Belongs to the peptidase A1 family.	Sequence Similarities		
GO:0004190 : aspartic-type endopeptidase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004190)	GO - Molecular Function		
GO:0006508 : proteolysis (https://www.ebi.ac.uk/QuickGO/term/GO:0006508)	GO - Biological Process		
GO:0044267 : cellular protein metabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0044267)			
GO:0007586 : digestion (https://www.ebi.ac.uk/QuickGO/term/GO:0007586)			
GO:0030163 : protein catabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0030163)			
GO:0070062 : extracellular exosome (https://www.ebi.ac.uk/QuickGO/term/GO:0070062)	GO - Cellular Component		
GO:0097486 : multivesicular body lumen (https://www.ebi.ac.uk/QuickGO/term/GO:0097486)			
Yes (https://www.gephebase.org/search-criteria?/and+Presumptive Null=~Yes~#gephebase-summary-title)			Presumptive Null
Gene Loss (https://www.gephebase.org/search-criteria?/and+Molecular Type=~Gene Loss~#gephebase-summary-title)			Molecular Type
Deletion (https://www.gephebase.org/search-criteria?/and+Aberration Type=~Deletion~#gephebase-summary-title)			Aberration Type

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Molecular Details of the Mutation

Absence of the gene in the genome sequence - high synteny

Experimental Evidence

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

Main Reference

Recurrent gene loss correlates with the evolution of stomach phenotypes in gnathostome history. (2014) (<https://pubmed.ncbi.nlm.nih.gov/24307675>)

Authors

Castro LF; GonÁsalves O; Mazan S; Tay BH; Venkatesh B; Wilson JM

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) (<https://www.gephebase.org/search-criteria?/or+Taxon+ID=^8049^/and+Trait=Digestion/or+Taxon+ID=^69293^/and+Trait=Digestion/or+Taxon+ID=^8128^/and+Trait=Digestion/or+Taxon+ID=^7955^/and+Trait=Digestion/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS

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