

GEPHE SUMMARY

pepsinogen A1 ( <a href="https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=~pepsinogen+A1~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=~pepsinogen+A1~#gephebase-summary-title</a> )	Gephebase Gene	GP00001930	GepheID
Published	Entry Status	Courtier	Main curator

PHENOTYPIC CHANGE

Physiology ( <a href="https://www.gephebase.org/search-criteria?/and+Trait+Category=~Physiology~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait+Category=~Physiology~#gephebase-summary-title</a> )	Trait Category
Digestion (absence of stomach) ( <a href="https://www.gephebase.org/search-criteria?/and+Trait=~Digestion+(absence+of+stomach)~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait=~Digestion+(absence+of+stomach)~#gephebase-summary-title</a> )	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
Taxon A	Ancestral State
Intergeneric or Higher ( <a href="https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=~Intergeneric+or+Higher~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=~Intergeneric+or+Higher~#gephebase-summary-title</a> )	Taxonomic Status

Taxon A #1	
Oreochromis niloticus ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Oreochromis+niloticus~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Oreochromis+niloticus~#gephebase-summary-title</a> )	Latin Name
Nile tilapia	Common Name
Oreochromis nilotica; Tilapia nilotica; Nile tilapia; Oreochromis niloticus (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; Acanthomorpha; Euacanthomorpha; Percomorpha; Ovalentaria; Cichlomorphae; Cichliformes; Cichlidae; African cichlids; Pseudocrenilabrinae; Oreochromini; Oreochromis	Lineage
Oreochromis () - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8139">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8139</a> )	Parent
8128 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8128">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=8128</a> )	NCBI Taxonomy ID
No	is Taxon A an Infrappecies?

Taxon B #1	
Takifugu rubripes ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Takifugu+rubripes~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Takifugu+rubripes~#gephebase-summary-title</a> )	Latin Name
torafugu	Common Name
Fugu rubripes; Sphaeroides rubripes; Tetraodon rubripes; torafugu; tiger puffer; Takifugu rubripes (Temminck & Schlegel, 1850)	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; Acanthomorpha; Euacanthomorpha; Percomorpha; Eupercaria; Tetraodontiformes; Tetraodontoidei; Tetradontoidea; Tetraodontidae; Takifugu	Lineage
Takifugu () - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=31032">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=31032</a> )	Parent
31033 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=31033">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=31033</a> )	NCBI Taxonomy ID
No	is Taxon B an Infrappecies?

Taxon A #2	
Gasterosteus aculeatus ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Gasterosteus+aculeatus~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Gasterosteus+aculeatus~#gephebase-summary-title</a> )	Latin Name
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; Acanthomorpha; Euacanthomorpha; Percomorpha;	Lineage

Taxon B #2	
Tetraodon nigroviridis ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Tetraodon+nigroviridis~#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Tetraodon+nigroviridis~#gephebase-summary-title</a> )	Latin Name
spotted green pufferfish	Common Name
spotted green pufferfish; Tetraodon nigroviridis Marion de Proce, 1822	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; Acanthomorpha; Euacanthomorpha; Percomorpha; Eupercaria; Tetraodontiformes; Tetraodontoidei; Tetradontoidea; Tetraodontidae;	Lineage

Eupercaria; Perciformes; Cottioidei; Gasterosteales; 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 Infrasppecies?  
No

Tetraodon  
Parent  
Tetraodon () - (Rank: genus)  
(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=47144>)  
NCBI Taxonomy ID  
99883  
(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=99883>)  
is Taxon B an Infrasppecies?  
No

## GENOTYPIC CHANGE

PGA4	Generic Gene Name	P0DJD7 ( <a href="http://www.uniprot.org/uniprot/P0DJD7">http://www.uniprot.org/uniprot/P0DJD7</a> )	UniProtKB Homo sapiens
-	Synonyms	0	GenebankID or UniProtKB
9606.ENSPO0000367391 ( <a href="http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSPO0000367391">http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSPO0000367391</a> )	String		
Belongs to the peptidase A1 family.	Sequence Similarities		
GO:0004190 : aspartic-type endopeptidase activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0004190">https://www.ebi.ac.uk/QuickGO/term/GO:0004190</a> )	GO - Molecular Function		
GO:0006508 : proteolysis ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0006508">https://www.ebi.ac.uk/QuickGO/term/GO:0006508</a> ) GO:0044267 : cellular protein metabolic process ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0044267">https://www.ebi.ac.uk/QuickGO/term/GO:0044267</a> ) GO:0007586 : digestion ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0007586">https://www.ebi.ac.uk/QuickGO/term/GO:0007586</a> ) GO:0030163 : protein catabolic process ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0030163">https://www.ebi.ac.uk/QuickGO/term/GO:0030163</a> )	GO - Biological Process		
GO:0070062 : extracellular exosome ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0070062">https://www.ebi.ac.uk/QuickGO/term/GO:0070062</a> ) GO:0097486 : multivesicular body lumen ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0097486">https://www.ebi.ac.uk/QuickGO/term/GO:0097486</a> )	GO - Cellular Component		
Yes ( <a href="https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title</a> )			Presumptive Null
Gene Loss ( <a href="https://www.gephebase.org/search-criteria?/and+Molecular Type=^Gene Loss^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Molecular Type=^Gene Loss^#gephebase-summary-title</a> )			Molecular Type
Deletion ( <a href="https://www.gephebase.org/search-criteria?/and+Aberration Type=^Deletion^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Aberration Type=^Deletion^#gephebase-summary-title</a> )			Aberration Type
-			Deletion Size
Absence of the gene in the genome sequence - high synteny			Molecular Details of the Mutation
Candidate Gene ( <a href="https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title</a> )			Experimental Evidence
Recurrent gene loss correlates with the evolution of stomach phenotypes in gnathostome history. (2014) ( <a href="https://pubmed.ncbi.nlm.nih.gov/24307675">https://pubmed.ncbi.nlm.nih.gov/24307675</a> )			Main Reference
Castro LF; Gonsalves O; Mazan S; Tay BH; Venkatesh B; Wilson JM			Authors
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.			Abstract
			Additional References

## RELATED GEPHE

4 (ATP4A, ATP4B, pepsinogen A2, pepsinogen A3) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=^8128^/and+Trait=Digestion/or+Taxon ID=^69293^/and+Trait=Digestion/or+Taxon ID=^31033^/and+Trait=Digestion/or+Taxon ID=^99883^/and+Trait=Digestion/and+groupHaplotypes=true#gephebase-summary-title>)  
Related Genes  
Related Haplotypes  
2 (<https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^pepsinogen A1^/and+Taxon ID=^8128^/or+Gene Gephebase=^pepsinogen A1^/and+Taxon ID=^69293^/or+Gene Gephebase=^pepsinogen A1^/and+Taxon ID=^31033^/or+Gene Gephebase=^pepsinogen A1^/and+Taxon ID=^99883^#gephebase-summary-title>)

## EXTERNAL LINKS

## COMMENTS

There are three pepsinogen A genes in teleost fishes - their nomenclature and phylogenetic relationships are different from Mammals pepsinogen genes - Not clear if this is independent evolution in *Tetraodon nigroviridis* and in *Takifugu rubripes* (no detailed phylogenetic tree in the paper)