GEPHE SUMMARY

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

GepheID
GP00002346

Entry Status
Published

Main curator
Courtier

PHENOTYPIC CHANGE

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

Trait
Fin morphology (skeleton; dorsal fin; caudal fin; tail; paired fin) (https://www.gephebase.org/search-criteria?/and+Trait=^Fin morphology (skeleton; dorsal fin; caudal fin; tail; paired fin)^#gephebase-summary-title)

Trait State in Taxon A
non bifurcated caudal axial skeleton
wild goldfish

Trait State in Taxon B
twin tail, bifurcated caudal axial skeleton
domesticated twin-tail goldfish

Ancestral State
Taxon A

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

Taxon A

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

Common Name
goldfish

Synonyms
Carassius carassius auratus; Cyprinus auratus; goldfish; Carassius auratus (Linnaeus, 1758); Cyprinus auratus Linnaeus, 1758; Carassius auratis

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; Cyprininae; Carassius

Parent
Carassius () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7956)

NCBI Taxonomy ID
7957 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7957)

is Taxon A an Infraspecies?
No

Taxon B

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

Common Name
goldfish

Synonyms
Carassius carassius auratus; Cyprinus auratus; goldfish; Carassius auratus (Linnaeus, 1758); Cyprinus auratus Linnaeus, 1758; Carassius auratis

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; Cyprininae; Carassius

Parent
Carassius () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7956)

NCBI Taxonomy ID
7957 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7957)

is Taxon B an Infraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
chdA

Synonyms
-

String
-

Sequence Similarities
Belongs to the chordin family.

GO - Molecular Function
-

GO - Biological Process
GO:0007389 : pattern specification process (https://www.ebi.ac.uk/QuickGO/term/GO:0007389)

UniProtKB Carassius auratus
W8VTE1 (http://www.uniprot.org/uniprot/W8VTE1)

GenebankID or UniProtKB
W8VTE1 (https://www.ncbi.nlm.nih.gov/nuccore/W8VTE1)

GO:0009790 : embryo development (https://www.ebi.ac.uk/QuickGO/term/GO:0009790)
GO - Cellular Component

-

Presumptive Null

Yes (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title)

Molecular Type

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

Aberration Type

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

SNP Coding Change

Nonsense

Molecular Details of the Mutation

stop codon in codon 127. GAG (E) -> TAG (STOP). Predicted to result in a truncated protein lacking the second to fourth CR domains.

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	GAG	TAG	-
Amino-acid	Glu	STP	127

Main Reference

The origin of the bifurcated axial skeletal system in the twin-tail goldfish. (2014) (https://pubmed.ncbi.nlm.nih.gov/24569511)

Authors

Abe G; Lee SH; Chang M; Liu SC; Tsai HY; Ota KG

Abstract

Twin-tail goldfish possess a bifurcated caudal axial skeleton. The scarcity of this trait in nature suggests that a rare mutation, which drastically altered the mechanisms underlying axial skeleton formation, may have occurred during goldfish domestication. However, little is known about the molecular development of twin-tail goldfish. Here we show that the bifurcated caudal skeleton arises from a mutation in the chordin gene, which affects embryonic dorsal-ventral (DV) patterning. We demonstrate that formation of the bifurcated caudal axial skeleton requires a stop-codon mutation in one of two recently duplicated chordin genes; this mutation may have occurred within approximately 600 years of domestication. We also report that the ventral tissues of the twin-tail strain are enlarged, and form the embryonic bifurcated fin fold. However, unlike previously described chordin-deficient embryos, this is not accompanied by a reduction in anterior-dorsal neural tissues. These results provide insight into large-scale evolution arising from artificial selection.

Additional References

The Genetic Basis of Morphological Diversity in Domesticated Goldfish. (2020) (https://pubmed.ncbi.nlm.nih.gov/32392470)

RELATED GEPHE

Related Genes

2 (Potassium channel subfamily K, Wnt receptor) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^7957^/and+Trait=Fin morphology/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS

GWAS was performed in the Kon et al. 2021 study and found strong association. Twin-tail individuals are homozygous for the mutation. Twin-tail goldfish share three characteristic phenotypes (accumulation of blood cells, bifurcated fin folds and skeletal defects in the vertebral column) with the zebrafish chordin mutant.