

GEPHE SUMMARY

cardinal (https://www.gephebase.org/search-criteria?/and+GeneGephebase=~cardinal~#gephebase-summary-title)	Gephebase Gene	GP00002666	GepheID
Published	Entry Status	Courtier	Main curator

PHENOTYPIC CHANGE

Morphology (https://www.gephebase.org/search-criteria?/and+TraitCategory=~Morphology~#gephebase-summary-title)	Trait Category		
Coloration (eyes) (https://www.gephebase.org/search-criteria?/and+Trait=~Coloration(eyes)~#gephebase-summary-title)	Trait		
Tribolium castaneum - wild-type allele - black eyes	Trait State in Taxon A		
Tribolium castaneum - red-1 allele - white eyes	Trait State in Taxon B		
Taxon A	Ancestral State		
Domesticated (https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=~Domesticated~#gephebase-summary-title)	Taxonomic Status		
	Taxon A	Taxon B	
Tribolium castaneum (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Tribolium+castaneum~#gephebase-summary-title)	Latin Name	Tribolium castaneum (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Tribolium+castaneum~#gephebase-summary-title)	Latin Name
red flour beetle	Common Name	red flour beetle	Common Name
red flour beetle; rust-red flour beetle; Tribolium castaneum (Herbst, 1797)	Synonyms	red flour beetle; rust-red flour beetle; Tribolium castaneum (Herbst, 1797)	Synonyms
species	Rank	species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Coleoptera; Polyphaga; Cucujiformia; Tenebrionoidea; Tenebrionidae; Tenebrionidae incertae sedis; Tribolium	Lineage	cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Coleoptera; Polyphaga; Cucujiformia; Tenebrionoidea; Tenebrionidae; Tenebrionidae incertae sedis; Tribolium	Lineage
Tribolium () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7069)	Parent	Tribolium () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7069)	Parent
7070 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7070)	NCBI Taxonomy ID	7070 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7070)	NCBI Taxonomy ID
No	is Taxon A an Intraspecies?	No	is Taxon B an Intraspecies?

GENOTYPIC CHANGE

cd	Generic Gene Name	Q9VCW2 (http://www.uniprot.org/uniprot/Q9VCW2)	UniProtKB Drosophila melanogaster
CG6969; Dmel\CG6969; HPX6; PHS; Dmel.CG6969	Synonyms	()	GenebankID or UniProtKB
7227.FBpp0083696 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7227.FBpp0083696)	String		
-	Sequence Similarities		
GO:0020037 : heme binding (https://www.ebi.ac.uk/QuickGO/term/GO:0020037)	GO - Molecular Function		
GO:0004601 : peroxidase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004601)			
GO:0140825 : lactoperoxidase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0140825)			
GO:1901216 : positive regulation of neuron death (https://www.ebi.ac.uk/QuickGO/term/GO:1901216)	GO - Biological Process		

GO:0006979 : response to oxidative stress
(<https://www.ebi.ac.uk/QuickGO/term/GO:0006979>)
GO:0070189 : kynurenine metabolic process
(<https://www.ebi.ac.uk/QuickGO/term/GO:0070189>)
GO:1900369 : negative regulation of post-transcriptional gene silencing by RNA
(<https://www.ebi.ac.uk/QuickGO/term/GO:1900369>)
GO:0006727 : ommochrome biosynthetic process
(<https://www.ebi.ac.uk/QuickGO/term/GO:0006727>)

GO - Cellular Component

GO:0016020 : membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0016020>)
GO:0005764 : lysosome (<https://www.ebi.ac.uk/QuickGO/term/GO:0005764>)

Presumptive Null

Yes ([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))

Molecular Type

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

Aberration Type

Deletion ([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))

Deletion Size

1-9 bp

Molecular Details of the Mutation

1-bp deletion in exon 6 that causes a frameshift mutation. Amino acid residues near the C-terminal end of the haem peroxidase domain are thus disrupted.

Experimental Evidence

Candidate Gene ([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))

Main Reference

Mutations in cardinal are responsible for the red-1 and peach eye color mutants of the red flour beetle *Tribolium castaneum*. (2020) (<https://pubmed.ncbi.nlm.nih.gov/32703438>)

Authors

Shirai Y; Daimon T

Abstract

Ommochromes are the major pigments found in the eyes, eggs, wings and epidermis of insects. Here, we report the identification and characterization of the gene responsible for red-1 locus of *Tribolium*, whose mutants have white eyes due to lack of ommochrome pigments in the eyes. Using a candidate gene approach, we demonstrated that red-1 and peach mutants have molecular defects in the cardinal gene, which encodes a haem peroxidase that is considered to convert 3-hydroxykynurenine into ommochromes in pigment granules. Our experiments showed that the expression pattern of cardinal correlates well with the progression of eye pigmentation during pupal stages. We performed gene editing experiments using the Receptor-Mediated Ovary Transduction of Cargo (ReMOT) Control technique to disrupt the cardinal gene by adult injection, and were able to establish a novel cardinal mutant line. Our complementation test provided definitive genetic evidence that cardinal is located at the red-1 locus. The present study will lead to a greater understanding of the function and diversity of ommochrome pathway genes in insects. Our successful use of ReMOT Control in beetles will facilitate the development of more efficient and versatile systems for insect genome editing by simple adult injection.

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Additional References

RELATED GEPHE

Related Genes

No matches found.

Related Haplotypes

1 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=~cardinal~/and+Taxon ID=~7070~/or+Gene Gephebase=~cardinal~/and+Taxon ID=~7070~#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene+Gephebase=~cardinal~/and+Taxon+ID=~7070~/or+Gene+Gephebase=~cardinal~/and+Taxon+ID=~7070~#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

The enzyme cardinal appears to catalyze the last step of ommin formation by using either 3-hydroxykynurenine or xanthommatin as substrates. Spontaneous mutation.