

## GEPHE SUMMARY

	Gephebase Gene	GephelD
cardinal ( <a href="https://www.gephebase.org/search-criteria?/and+Gene">https://www.gephebase.org/search-criteria?/and+Gene</a> Gephebase="cardinal">#gephebase-summary-title)	GP00002666	Main curator
Published	Entry Status	Courtier

## PHENOTYPIC CHANGE

	Trait Category
Morphology ( <a href="https://www.gephebase.org/search-criteria?/and+Trait">https://www.gephebase.org/search-criteria?/and+Trait</a> Category="Morphology">#gephebase-summary-title)	Trait
Coloration (eyes) ( <a href="https://www.gephebase.org/search-criteria?/and+Trait=^Coloration">https://www.gephebase.org/search-criteria?/and+Trait=^Coloration</a> (eyes)#gephebase-summary-title)	Trait State in Taxon A
Tribolium castaneum - wild-type allele - black eyes	Trait State in Taxon B
Tribolium castaneum - red-1 allele - white eyes	Ancestral State
Taxon A	Taxonomic Status

Taxon A	Latin Name	Taxon B	Latin Name
Tribolium castaneum ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Tribolium+castaneum">#gephebase-summary-title)</a>	Common Name	Tribolium castaneum ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Tribolium+castaneum">#gephebase-summary-title)</a>	Common Name
red flour beetle	Synonyms	red flour beetle	Synonyms
red flour beetle; rust-red flour beetle; Tribolium castaneum (Herbst, 1797)	Rank	red flour beetle; rust-red flour beetle; Tribolium castaneum (Herbst, 1797)	Rank
species	Lineage	species	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	Parent	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	Parent
Tribolium () - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7069">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7069</a> )	NCBI Taxonomy ID	Tribolium () - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7069">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7069</a> )	NCBI Taxonomy ID
7070 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7070">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7070</a> )	is Taxon A an Infraspecies?	7070 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7070">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7070</a> )	is Taxon B an Infraspecies?
No		No	

## GENOTYPIC CHANGE

cd	Generic Gene Name	UniProtKB Drosophila melanogaster
CG6969; Dmel\CG6969; HPX6; PHS; Dmel_CG6969	Synonyms	GenebankID or UniProtKB
7227.FBpp0083696 ( <a href="http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0083696">http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0083696</a> )	String	0
-	Sequence Similarities	
GO:0020037 : heme binding ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0020037">https://www.ebi.ac.uk/QuickGO/term/GO:0020037</a> ) GO:0004601 : peroxidase activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0004601">https://www.ebi.ac.uk/QuickGO/term/GO:0004601</a> ) GO:0140825 : lactoperoxidase activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0140825">https://www.ebi.ac.uk/QuickGO/term/GO:0140825</a> )	GO - Molecular Function	
GO:1901216 : positive regulation of neuron death ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:1901216">https://www.ebi.ac.uk/QuickGO/term/GO:1901216</a> )	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>)

Molecular Type

Coding (<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>)

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>)

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

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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>)

## 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.