

GEPHE SUMMARY

cardinal (https://www.gephebase.org/search-criteria?/and+GeneGephebase=^cardinal^#gephebase-summary-title)	Gephebase Gene	GP00002667	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		
Bombyx mori - wild-type allele - black eyes and dark eggs	Trait State in Taxon A		
Bombyx mori - pink-eyed white egg (pe) allele - red eyes and white or pale pink eggs	Trait State in Taxon B		
	Ancestral State		
Taxon A		Taxon B	
Domesticated (https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=~Domesticated^#gephebase-summary-title)	Taxonomic Status		
	Latin Name		Latin Name
Bombyx mori (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Bombyxmori^#gephebase-summary-title)		Bombyx mori (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Bombyxmori^#gephebase-summary-title)	
	Common Name		Common Name
domestic silkworm		domestic silkworm	
	Synonyms		Synonyms
domestic silkworm; silk moth; silkworm; Bombyx mori Linnaeus, 1758		domestic silkworm; silk moth; silkworm; Bombyx mori Linnaeus, 1758	
	Rank		Rank
species		species	
	Lineage		Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphimesnoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditrysia; Obtectomera; Bombycoidea; Bombycidae; Bombycinae; Bombyx		cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphimesnoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditrysia; Obtectomera; Bombycoidea; Bombycidae; Bombycinae; Bombyx	
	Parent		Parent
Bombyx () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7090)		Bombyx () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7090)	
	NCBI Taxonomy ID		NCBI Taxonomy ID
7091 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7091)		7091 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7091)	
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?
No		No	

GENOTYPIC CHANGE

cd	Generic Gene Name	UniProtKB Drosophila melanogaster
CG6969; Dmel\CG6969; HPX6; PHS; Dmel_CG6969	Synonyms	Q9VCW2 (http://www.uniprot.org/uniprot/Q9VCW2)
	String	GenebankID or UniProtKB
7227.FBpp0083696 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0083696)		()
	Sequence Similarities	
-		
	GO - Molecular Function	
GO:0020037 : heme binding (https://www.ebi.ac.uk/QuickGO/term/GO:0020037)		
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 - Biological Process	
GO:1901216 : positive regulation of neuron death		

(<https://www.ebi.ac.uk/QuickGO/term/GO:1901216>)
 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

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

SNP Coding Change

-

Molecular Details of the Mutation

Missense mutation in a conserved motif in exon 9. The tryptophan residue which is converted to arginine in the two pe strains is widely conserved in holometabolous insects.

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))

	Taxon A	Taxon B	Position
Codon	TGG	CGG	-
Amino-acid	Trp	Arg	-

Main Reference

Positional cloning of a Bombyx pink-eyed white egg locus reveals the major role of cardinal in ommochrome synthesis. (2016) (<https://pubmed.ncbi.nlm.nih.gov/26328757>)

Authors

Osanai-Futahashi M; Tatematsu KI; Futahashi R; Narukawa J; Takasu Y; Kayukawa T; Shinoda T; Ishige T; Yajima S; Tamura T; Yamamoto K; Sezutsu H

Abstract

Ommochromes are major insect pigments involved in coloration of compound eyes, eggs, epidermis and wings. In the silkworm *Bombyx mori*, adult compound eyes and eggs contain a mixture of the ommochrome pigments such as ommin and xanthommatin. Here, we identified the gene involved in ommochrome biosynthesis by positional cloning of *B. mori* egg and eye color mutant pink-eyed white egg (*pe*). The recessive homozygote of *pe* has bright red eyes and white or pale pink eggs instead of a normal dark coloration due to the decrease of dark ommochrome pigments. By genetic linkage analysis, we narrowed down the *pe*-linked region to ~258â€‰kb, containing 17 predicted genes. RNA sequencing analyses showed that the expression of one candidate gene, the ortholog of *Drosophila* haem peroxidase cardinal, coincided with egg pigmentation timing, similar to other ommochrome-related genes such as *Bm-scarlet* and *Bm-re*. In two *pe* strains, a common missense mutation was found within a conserved motif of *B. mori* cardinal homolog (*Bm-cardinal*). RNA interference-mediated knockdown and transcription activator-like effector nuclease (TALEN)-mediated knockout of the *Bm-cardinal* gene produced the same phenotype as *pe* in terms of egg, adult eye and larval epidermis coloration. A complementation test of the *pe* mutant with the TALEN-mediated *Bm-cardinal*-deficient strain showed that the mutant phenotype could not be rescued, indicating that *Bm-cardinal* is responsible for *pe*. Moreover, knockdown of the cardinal homolog in *Tribolium castaneum* also induced red compound eyes. Our results indicate that cardinal plays a major role in ommochrome synthesis of holometabolous insects.

Additional References

RELATED GEPHE

Related Genes

9 (apontic-like, *Bm-iAANAT*, cortex, SCARB1, SCRB15, Wnt1, Carotenoid-binding protein (CBP), Tyrosine hydroxylase, UGT86 (*Bm-UGT10286*)) ([https://www.gephebase.org/search-criteria?/or+Taxon ID=~7091^/and+Trait=Coloration/and+groupHaplotypes=true#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Taxon+ID=~7091^/and+Trait=Coloration/and+groupHaplotypes=true#gephebase-summary-title))

Related Haplotypes

No matches found.

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.

