

# GEPHE SUMMARY

	Gephebase Gene	GephelD
prophenoloxidase 3 (PPO3) ( <a href="https://www.gephebase.org/search-criteria/?and+Gene">https://www.gephebase.org/search-criteria/?and+Gene</a> Gephebase="prophenoloxidase 3 (PPO3)"#gephebase-summary-title)	GP00001781	Main curator
Published	Entry Status	Courtier

## PHENOTYPIC CHANGE

Trait Category
Physiology ( <a href="https://www.gephebase.org/search-criteria/?and+Trait">https://www.gephebase.org/search-criteria/?and+Trait</a> Category="Physiology">#gephebase-summary-title)
Immune response (melanotic encapsulation by lamellocytes) ( <a href="#">https://www.gephebase.org/search-criteria/?and+Trait=^Immune+response+(melanotic+encapsulation+by+lamellocytes)"#gephebase-summary-title</a> )
Trait State in Taxon A
D. simulans and D. mauritiana - presence of lamellocytes and ability to melanotically encapsulate parasitoids
Trait State in Taxon B
D. sechellia - no lamellocytes and inability to melanotically encapsulate parasitoids
Ancestral State
Taxon A
Taxonomic Status
Interspecific ( <a href="https://www.gephebase.org/search-criteria/?and+Taxonomic">https://www.gephebase.org/search-criteria/?and+Taxonomic</a> Status="Interspecific">#gephebase-summary-title)

Taxon A #1	Latin Name
Drosophila simulans ( <a href="#">https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=^Drosophila+simulans"&gt;#gephebase-summary-title</a> )	
-	Common Name
-	Synonyms
-	Rank
species	Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Diptera; Brachycera; Muscomorpha; Eremoneura; Cyclorrhapha; Schizophora; Acalyptratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup	
melanogaster subgroup () - (Rank: species subgroup) ( <a href="#">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351</a> )	Parent
NCBI Taxonomy ID	
7240 ( <a href="#">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7240</a> )	
is Taxon A an Infraspecies?	
No	

Taxon A #2	Latin Name
Drosophila mauritiana ( <a href="#">https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=^Drosophila+mauritiana"&gt;#gephebase-summary-title</a> )	
-	Common Name
-	Synonyms
-	Rank
species	Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Diptera; Brachycera; Muscomorpha; Eremoneura; Cyclorrhapha; Schizophora; Acalyptratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora;	

Taxon B	Latin Name
Drosophila sechellia ( <a href="#">https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=^Drosophila+sechellia"&gt;#gephebase-summary-title</a> )	
-	Common Name
-	Synonyms
-	Rank
Drosophila sechellia Tsacas and Bachli, 1981	Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Diptera; Brachycera; Muscomorpha; Eremoneura; Cyclorrhapha; Schizophora; Acalyptratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup	
melanogaster subgroup () - (Rank: species subgroup) ( <a href="#">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351</a> )	Parent
NCBI Taxonomy ID	
7238 ( <a href="#">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7238</a> )	
is Taxon B an Infraspecies?	
No	

melanogaster group; melanogaster subgroup	Parent
melanogaster subgroup () - (Rank: species subgroup) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351</a> )	NCBI Taxonomy ID
7226 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7226">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7226</a> )	is Taxon A an Infraspecies?
No	

## GENOTYPIC CHANGE

PPO3	Generic Gene Name	UniProtKB Drosophila melanogaster
	Synonyms	<a href="http://www.uniprot.org/uniprot/Q9W1V6">Q9W1V6</a> ( <a href="http://www.uniprot.org/uniprot/Q9W1V6">http://www.uniprot.org/uniprot/Q9W1V6</a> )
CG2952; CG42640; Dmel\CG42640; DmePPO3; Dox-A3; Pro-PO3; proPO59; ProPO59; Dox-3		GenebankID or UniProtKB
	String	
7227.FBpp0291496 ( <a href="http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0291496">http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0291496</a> )	Sequence Similarities	
Belongs to the tyrosinase family.	GO - Molecular Function	
GO:0046872 : metal ion binding ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0046872">https://www.ebi.ac.uk/QuickGO/term/GO:0046872</a> )		
GO:0004503 : monophenol monooxygenase activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0004503">https://www.ebi.ac.uk/QuickGO/term/GO:0004503</a> )		
GO:0036264 : dopamine monooxygenase activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0036264">https://www.ebi.ac.uk/QuickGO/term/GO:0036264</a> )		
GO:0036263 : L-DOPA monooxygenase activity ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0036263">https://www.ebi.ac.uk/QuickGO/term/GO:0036263</a> )		
	GO - Biological Process	
GO:0042438 : melanin biosynthetic process ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0042438">https://www.ebi.ac.uk/QuickGO/term/GO:0042438</a> )		
GO:0042417 : dopamine metabolic process ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0042417">https://www.ebi.ac.uk/QuickGO/term/GO:0042417</a> )		
GO:0035011 : melanotic encapsulation of foreign target ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0035011">https://www.ebi.ac.uk/QuickGO/term/GO:0035011</a> )		
	GO - Cellular Component	
GO:0005737 : cytoplasm ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0005737">https://www.ebi.ac.uk/QuickGO/term/GO:0005737</a> )		Presumptive Null
GO:0005576 : extracellular region ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0005576">https://www.ebi.ac.uk/QuickGO/term/GO:0005576</a> )		
Yes ( <a href="https://www.gephbase.org/search-criteria/?and+Presumptive%20Null=%27Yes%27#gephbase-summary-title">https://www.gephbase.org/search-criteria/?and+Presumptive Null=%27Yes%27#gephbase-summary-title</a> )		Molecular Type
Coding ( <a href="https://www.gephbase.org/search-criteria/?and+Molecular%20Type=%27Coding%27#gephbase-summary-title">https://www.gephbase.org/search-criteria/?and+Molecular Type=%27Coding%27#gephbase-summary-title</a> )		Aberration Type
SNP ( <a href="https://www.gephbase.org/search-criteria/?and+Aberration%20Type=%27SNP%27#gephbase-summary-title">https://www.gephbase.org/search-criteria/?and+Aberration Type=%27SNP%27#gephbase-summary-title</a> )		SNP Coding Change
Nonsense	Molecular Details of the Mutation	
amino acid change at position 48 which converts the terminal glutamine residue of the propeptide region to a stop codon, and is predicted to generate a truncated version of the PPO3 protein		
		Experimental Evidence
Candidate Gene ( <a href="https://www.gephbase.org/search-criteria/?and+Experimental%20Evidence=%27Candidate%20Gene%27#gephbase-summary-title">https://www.gephbase.org/search-criteria/?and+Experimental Evidence=%27Candidate Gene%27#gephbase-summary-title</a> )		

Taxon A	Taxon B	Position
Codon	-	-
Amino-acid	Glu	STP
		48

Drosophila innate immunity: regional and functional specialization of prophenoloxidases. (2015) ( <a href="https://pubmed.ncbi.nlm.nih.gov/26437768">https://pubmed.ncbi.nlm.nih.gov/26437768</a> )	Main Reference
Dudzic JP; Kondo S; Ueda R; Bergman CM; Lemaitre B	Authors
The diversification of immune systems during evolution involves the expansion of particular gene families in given phyla. A better understanding of the metazoan immune system requires an analysis of the logic underlying such immune gene amplification. This analysis is now within reach due to the ease with which we can generate multiple mutations in an organism. In this paper, we analyze the contribution of the three Drosophila prophenoloxidases (PPOs) to host defense by generating single, double and triple mutants. PPOs are enzymes that catalyze the production of melanin at the site of infection and around parasites. They are the rate-limiting enzymes that contribute to the melanization reaction, a major immune mechanism of arthropods. The number of PPO-encoding genes is variable among insects, ranging from one in the bee to ten in the mosquito.	Abstract
By analyzing mutations alone and in combination, we ascribe a specific function to each of the three PPOs of Drosophila. Our study confirms that two PPOs produced by crystal cells, PPO1	

and PPO2, contribute to the bulk of melanization in the hemolymph, upon septic or clean injury. In contrast, PPO3, a PPO restricted to the *D. melanogaster* group, is expressed in lamellocytes and contributes to melanization during the encapsulation process. Interestingly, another overlapping set of PPOs, PPO2 and PPO3, achieve melanization of the capsule upon parasitoid wasp infection.

The use of single or combined mutations allowed us to show that each PPO mutant has a specific phenotype, and that knocking out two of three genes is required to abolish fully a particular function. Thus, *Drosophila* PPOs have partially overlapping functions to optimize melanization in at least two conditions: following injury or during encapsulation. Since PPO3 is restricted to the *D. melanogaster* group, this suggests that production of PPO by lamellocytes emerged as a recent defense mechanism against parasitoid wasps. We conclude that differences in spatial localization, immediate or late availability, and mode of activation underlie the functional diversification of the three *Drosophila* PPOs, with each of them having non-redundant but overlapping functions.

[Additional References](#)

## RELATED GEPHE

### Related Genes

No matches found.

### Related Haplotypes

No matches found.

## EXTERNAL LINKS

## COMMENTS

There is also a loss of PPO3 expression in *D. sechellia* (the causal mutation(s) are unknown)