

GEPHE SUMMARY

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

PHENOTYPIC CHANGE

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

Taxon A #1	Latin Name
<i>Drosophila simulans</i>	
(<a ^drosophila="" a="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" simulans^#gephebase-summary-title)<="">)	
	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; Acalypratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup	
	Parent
melanogaster subgroup () - (Rank: species subgroup)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32351))	
	NCBI Taxonomy ID
7240	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7240))	
	is Taxon A an Intraspecies?
No	

Taxon B	Latin Name
<i>Drosophila sechellia</i>	
(<a ^drosophila="" a="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" sechellia^#gephebase-summary-title)<="">)	
	Common Name
-	
	Synonyms
<i>Drosophila sechellia</i> Tsacas and Bachli, 1981	
	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; Acalypratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup	
	Parent
melanogaster subgroup () - (Rank: species subgroup)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32351))	
	NCBI Taxonomy ID
7238	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7238))	
	is Taxon B an Intraspecies?
No	

Taxon A #2	Latin Name
<i>Drosophila mauritiana</i>	
(<a ^drosophila="" a="" href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=" mauritiana^#gephebase-summary-title)<="">)	
	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; Acalypratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora;	

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

GENOTYPIC CHANGE

PPO3
 Generic Gene Name
 Q9W1V6 (http://www.uniprot.org/uniprot/Q9W1V6)
 UniProtKB Drosophila melanogaster
 Synonyms
 CG2952; CG42640; Dmel\CG42640; DmePPO3; Dox-A3; Pro-PO3; proPO59; ProPO59; Dox-3
 ()
 GenebankID or UniProtKB
 String
 7227.FBpp0291496
 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier= 7227.FBpp0291496)
 Sequence Similarities
 Belongs to the tyrosinase family.
 GO - Molecular Function
 GO:0046872 : metal ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0046872)
 GO:0004503 : monophenol monooxygenase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004503)
 GO:0036264 : dopamine monooxygenase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0036264)
 GO:0036263 : L-DOPA monooxygenase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0036263)
 GO - Biological Process
 GO:0042438 : melanin biosynthetic process (https://www.ebi.ac.uk/QuickGO/term/GO:0042438)
 GO:0042417 : dopamine metabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0042417)
 GO:0035011 : melanotic encapsulation of foreign target (https://www.ebi.ac.uk/QuickGO/term/GO:0035011)
 GO - Cellular Component
 GO:0005737 : cytoplasm (https://www.ebi.ac.uk/QuickGO/term/GO:0005737)
 GO:0005576 : extracellular region (https://www.ebi.ac.uk/QuickGO/term/GO:0005576)
 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
 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 (https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title)

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

Main Reference
 Drosophila innate immunity: regional and functional specialization of prophenoloxidases. (2015) (https://pubmed.ncbi.nlm.nih.gov/26437768)

Authors
 Dudzic JP; Kondo S; Ueda R; Bergman CM; Lemaitre B

Abstract
 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.

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

No matches found.

[Related Genes](#)

No matches found.

[Related Haplotypes](#)

EXTERNAL LINKS

COMMENTS

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