

GEPHE SUMMARY

	Gephebase Gene		GepheID
Acetylcholinesterase (Ace-2) (https://www.gephebase.org/search-criteria?/and+Gene)		GP00002011	
Gephebase="Acetylcholinesterase (Ace-2)"#gephebase-summary-title)			Main curator
Published	Entry Status	Courtier	

PHENOTYPIC CHANGE

	Trait Category		
Physiology (https://www.gephebase.org/search-criteria?/and+Trait)			
Category="Physiology"#gephebase-summary-title)	Trait		
Xenobiotic resistance (insecticide) (<a (insecticide)"#gephebase-summary-title"="" href="https://www.gephebase.org/search-criteria?/and+Trait=" resistance="" xenobiotic="">https://www.gephebase.org/search-criteria?/and+Trait="Xenobiotic resistance (insecticide)"#gephebase-summary-title)			
	Trait State in Taxon A		
Drosophila melanogaster - sensitive			
	Trait State in Taxon B		
Drosophila melanogaster - resistant - Saltillo strain			
	Ancestral State		
Taxon A			
	Taxonomic Status		
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic)			
Status="Intraspecific"#gephebase-summary-title)			
Taxon A		Taxon B	
	Latin Name		Latin Name
Drosophila melanogaster		Drosophila melanogaster	
(https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Drosophila melanogaster"#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Drosophila melanogaster"#gephebase-summary-title)	
	Common Name		Common Name
fruit fly		fruit fly	
	Synonyms		Synonyms
Sophophora melanogaster; fruit fly; Drosophila melanogaster Meigen, 1830; Sophophora melanogaster (Meigen, 1830); Drosophila melangaster		Sophophora melanogaster; fruit fly; Drosophila melanogaster Meigen, 1830; Sophophora melanogaster (Meigen, 1830); Drosophila melangaster	
	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; Diptera; Brachycera; Muscomorpha; Eremoneura; Cyclorrhapha; Schizophora; Acalyptratae; Ephydroidea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup		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	
	Parent		Parent
melanogaster subgroup () - (Rank: species subgroup)		melanogaster subgroup () - (Rank: species subgroup)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351)	
	NCBI Taxonomy ID		NCBI Taxonomy ID
7227		7227	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7227)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7227)	
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?
No		Yes	
			Taxon B Description
		Saltillo strain	

GENOTYPIC CHANGE

	Generic Gene Name		UniProtKB Drosophila melanogaster
Ace		P07140 (http://www.uniprot.org/uniprot/P07140)	
	Synonyms		GenebankID or UniProtKB
AcChE; ace; ACE; ace-2; ache; AchE; AChE; CG17907; CHE; dAChE; dmAChE; DmAChE; Dmel\CG17907; Dm_ace; FBgn0000024; l(3)26; l(3)87Ed		()	
	String		
7227.FBpp0289713			
(http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7227.FBpp0289713)			
	Sequence Similarities		
Belongs to the type-B carboxylesterase/lipase family.			
	GO - Molecular Function		
GO:0042803 : protein homodimerization activity			

(<https://www.ebi.ac.uk/QuickGO/term/GO:0042803>)
 GO:0003990 : acetylcholinesterase activity
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0003990>)
 GO:0004104 : cholinesterase activity (<https://www.ebi.ac.uk/QuickGO/term/GO:0004104>)
 GO:0043199 : sulfate binding (<https://www.ebi.ac.uk/QuickGO/term/GO:0043199>)
 GO - Biological Process

GO:0006581 : acetylcholine catabolic process
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0006581>)
 GO:0001507 : acetylcholine catabolic process in synaptic cleft
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0001507>)
 GO:0007268 : chemical synaptic transmission
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0007268>)
 GO:0042426 : choline catabolic process
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0042426>)
 GO:0042331 : phototaxis (<https://www.ebi.ac.uk/QuickGO/term/GO:0042331>)
 GO - Cellular Component

GO:0005886 : plasma membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0005886>)
 GO:0005737 : cytoplasm (<https://www.ebi.ac.uk/QuickGO/term/GO:0005737>)
 GO:0031225 : anchored component of membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0031225>)
 GO:0030054 : cell junction (<https://www.ebi.ac.uk/QuickGO/term/GO:0030054>)
 GO:0043083 : synaptic cleft (<https://www.ebi.ac.uk/QuickGO/term/GO:0043083>)

Mutation #1

No (<https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title>) Presumptive Null
 Coding (<https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title>) Molecular Type
 SNP (<https://www.gephebase.org/search-criteria?/and+Aberration Type=^SNP^#gephebase-summary-title>) Aberration Type
 Nonsynonymous SNP Coding Change
 Phe115Ser (position 78 in the corresponding mature Torpedo AChE). Tested in vitro in Xenopus oocytes Molecular Details of the Mutation
 Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title>) Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Phe	Ser	78

Resistance-associated point mutations in insecticide-insensitive acetylcholinesterase. (1994) (<https://pubmed.ncbi.nlm.nih.gov/8016090>) Main Reference
 Mutero A; Pralavorio M; Bride JM; Fournier D Authors
 Extensive utilization of pesticides against insects provides us with a good model for studying the adaptation of a eukaryotic genome to a strong selective pressure. One mechanism of resistance is the alteration of acetylcholinesterase (EC 3.1.1.7), the molecular target for organophosphates and carbamates. Here, we report the sequence analysis of the Ace gene in several resistant field strains of *Drosophila melanogaster*. This analysis resulted in the identification of five point mutations associated with reduced sensitivities to insecticides. In some cases, several of these mutations were found to be combined in the same protein, leading to different resistance patterns. Our results suggest that recombination between resistant alleles preexisting in natural populations is a mechanism by which insects rapidly adapt to new selective pressures. Abstract
 Additional References

Mutation #2

No (<https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title>) Presumptive Null
 Coding (<https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title>) Molecular Type
 SNP (<https://www.gephebase.org/search-criteria?/and+Aberration Type=^SNP^#gephebase-summary-title>) Aberration Type
 Nonsynonymous SNP Coding Change
 Ile199Val (position 129 in the corresponding mature Torpedo AChE). Tested in vitro in Xenopus oocytes Molecular Details of the Mutation
 Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title>) Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Ile	Val	129

Resistance-associated point mutations in insecticide-insensitive acetylcholinesterase. (1994) (<https://pubmed.ncbi.nlm.nih.gov/8016090>)

Main Reference

Mutero A; Pralavorio M; Bride JM; Fournier D

Authors

Abstract

Extensive utilization of pesticides against insects provides us with a good model for studying the adaptation of a eukaryotic genome to a strong selective pressure. One mechanism of resistance is the alteration of acetylcholinesterase (EC 3.1.1.7), the molecular target for organophosphates and carbamates. Here, we report the sequence analysis of the Ace gene in several resistant field strains of *Drosophila melanogaster*. This analysis resulted in the identification of five point mutations associated with reduced sensitivities to insecticides. In some cases, several of these mutations were found to be combined in the same protein, leading to different resistance patterns. Our results suggest that recombination between resistant alleles preexisting in natural populations is a mechanism by which insects rapidly adapt to new selective pressures.

Additional References

Mutations of acetylcholinesterase which confer insecticide resistance in *Drosophila melanogaster* populations. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15018651>)

Mutation #3

No (<https://www.gephebase.org/search-criteria?/and+Presumptive Null=~No^#gephebase-summary-title>)

Presumptive Null

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

Molecular Type

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

Aberration Type

Nonsynonymous

SNP Coding Change

Gly303Ala (position 227 in the corresponding mature Torpedo AChE). Tested in vitro in *Xenopus* oocytes

Molecular Details of the Mutation

Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=~Candidate Gene^#gephebase-summary-title>)

Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Gly	Ala	303

Resistance-associated point mutations in insecticide-insensitive acetylcholinesterase. (1994) (<https://pubmed.ncbi.nlm.nih.gov/8016090>)

Main Reference

Mutero A; Pralavorio M; Bride JM; Fournier D

Authors

Abstract

Extensive utilization of pesticides against insects provides us with a good model for studying the adaptation of a eukaryotic genome to a strong selective pressure. One mechanism of resistance is the alteration of acetylcholinesterase (EC 3.1.1.7), the molecular target for organophosphates and carbamates. Here, we report the sequence analysis of the Ace gene in several resistant field strains of *Drosophila melanogaster*. This analysis resulted in the identification of five point mutations associated with reduced sensitivities to insecticides. In some cases, several of these mutations were found to be combined in the same protein, leading to different resistance patterns. Our results suggest that recombination between resistant alleles preexisting in natural populations is a mechanism by which insects rapidly adapt to new selective pressures.

Additional References

Mutations of acetylcholinesterase which confer insecticide resistance in *Drosophila melanogaster* populations. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15018651>)

Mutation #4

No (<https://www.gephebase.org/search-criteria?/and+Presumptive Null=~No^#gephebase-summary-title>)

Presumptive Null

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

Molecular Type

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

Aberration Type

Nonsynonymous

SNP Coding Change

Phe368Tyr also named Phe330Tyr (position 288 in the corresponding mature Torpedo AChE). Tested in vitro in *Xenopus* oocytes

Molecular Details of the Mutation

Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=~Candidate Gene^#gephebase-summary-title>)

Experimental Evidence

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Phe	Tyr	368

Acetylcholinesterase. Two types of modifications confer resistance to insecticide. (1992) (<https://pubmed.ncbi.nlm.nih.gov/1629220>)

Main Reference

Authors
Fournier D; Bride JM; Hoffmann F; Karch F

Abstract
Quantitative and qualitative changes in acetylcholinesterase confer resistance to insecticides. We have constructed several *Drosophila melanogaster* strains producing various amounts of enzyme by P-mediated transformation. Toxicological analysis of these strains demonstrates that resistance to organophosphorus insecticides is correlated with the amount of acetylcholinesterase in the central nervous system. Resistance may also be qualitatively determined. Comparison of the *Drosophila* acetylcholinesterase gene between a resistant strain caught in the wild and a wild type susceptible strain only revealed one nucleotide transition resulting in the replacement of a phenylalanine by a tyrosine. Flies mutant for acetylcholinesterase and rescued with a minigene mutagenized for this same transition produced an altered enzyme which renders flies resistant to pesticides.

Additional References
Resistance-associated point mutations in insecticide-insensitive acetylcholinesterase. (1994) (<https://pubmed.ncbi.nlm.nih.gov/8016090>)
Mutations of acetylcholinesterase which confer insecticide resistance in *Drosophila melanogaster* populations. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15018651>)

RELATED GEPHE

19 (alcohol dehydrogenase (Adh), Aldehyde dehydrogenase (Aldh), CG11699, Cyp12d1, Cyp28d1, Cyp28d1-Cyp28d2, cyp6d2, cyp6g1, glutamate-gated chloride channel (GluCl), GSS (glutathione synthetase), GSTE1-E10 cluster, kin of irre (kire), para (kdr), PHGPx, resistance to dieldrin, RnrS, SOD1, Ugt86Dd, CHKov1) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=~7227^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Genes

4 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^Acetylcholinesterase \(Ace-2\)^/and+Taxon ID=~7227^/or+Gene Gephebase=^Acetylcholinesterase \(Ace-2\)^/and+Taxon ID=~7227^#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^Acetylcholinesterase (Ace-2)^/and+Taxon ID=~7227^/or+Gene Gephebase=^Acetylcholinesterase (Ace-2)^/and+Taxon ID=~7227^#gephebase-summary-title))

Related Haplotypes

EXTERNAL LINKS

COMMENTS

@SeveralMutationsWithEffect @Epistasis - <http://flybase.org/reports/FBal0295397> - <http://flybase.org/reports/FBal0295402> - <http://flybase.org/reports/FBal0295403> - <http://flybase.org/reports/FBal0295404>