

GEPHE SUMMARY

	Gephebase Gene		GepheID
Acetylcholinesterase (Ace-1) (https://www.gephebase.org/search-criteria?/and+Gene)		GP00001372	
Gephebase="Acetylcholinesterase (Ace-1)"#gephebase-summary-title)			Main curator
Published	Entry Status	Prigent	

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		
Anopheles gambiae Mosquitoes- KisumuP- susceptible to OP and CX insecticides ; wild type for viability and fertility			
	Trait State in Taxon B		
Anopheles gambiae Mosquitoes- Acerduplikis ; resistant to OP and CX insecticides ; slightly lower viability than wildtype			
	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
Anopheles gambiae		Anopheles gambiae	
(https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Anopheles gambiae"#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Anopheles gambiae"#gephebase-summary-title)	
	Common Name		Common Name
African malaria mosquito		African malaria mosquito	
	Synonyms		Synonyms
Anopheles gambiae S; African malaria mosquito; Anopheles gambiae Giles, 1902; Anopheles gambia		Anopheles gambiae S; African malaria mosquito; Anopheles gambiae Giles, 1902; Anopheles gambia	
	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; Nematocera; Culicomorpha; Culicoidea; Culicidae; Anophelinae; Anopheles; Cellia; Pyretophorus; gambiae species complex		cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Diptera; Nematocera; Culicomorpha; Culicoidea; Culicidae; Anophelinae; Anopheles; Cellia; Pyretophorus; gambiae species complex	
	Parent		Parent
gambiae species complex () - (Rank: no rank)		gambiae species complex () - (Rank: no rank)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 44542)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 44542)	
	NCBI Taxonomy ID		NCBI Taxonomy ID
7165		7165	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7165)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7165)	
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?
Yes		Yes	
	Taxon A Description		Taxon B Description
Anopheles gambiae Mosquitoes- KisumuP- susceptible to OP and CX insecticides ; wild type for viability and fertility		Anopheles gambiae Mosquitoes- Acerduplikis ; resistant to OP and CX insecticides ; slightly lower viability than wildtype	

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)

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

Presumptive Null

Gene Amplification (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Gene Amplification^#gephebase-summary-title)

Molecular Type

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

Aberration Type

100-1000 kb

Insertion Size

Strict tandem duplication of 203kb encompassing 12 genes ; ace1 heterogeneous gene duplication (susceptible G119 and resistant S119 copies)

Molecular Details of the Mutation

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

Experimental Evidence

The ace-1 Locus Is Amplified in All Resistant Anopheles gambiae Mosquitoes: Fitness Consequences of Homogeneous and Heterogeneous Duplications. (2016)
 (https://pubmed.ncbi.nlm.nih.gov/27918584)

Main Reference

Assogba BS; Milesi P; Djogb  nou LS; Berthomieu A; Makoundou P; Baba-Moussa LS; Fiston-Lavier AS; Belkhir K; Labb   P; Weill M

Authors

Gene copy-number variations are widespread in natural populations, but investigating their phenotypic consequences requires contemporary duplications under selection. Such duplications have been found at the ace-1 locus (encoding the organophosphate and carbamate insecticides' target) in the mosquito Anopheles gambiae (the major malaria vector); recent studies have revealed their intriguing complexity, consistent with the involvement of various numbers and types (susceptible or resistant to insecticide) of copies. We used an integrative approach, from genome to phenotype level, to investigate the influence of duplication architecture and gene-dosage on mosquito fitness. We found that both heterogeneous (i.e., one susceptible and one resistant ace-1 copy) and homogeneous (i.e., identical resistant copies) duplications segregated in field populations. The number of copies in homogeneous duplications was variable and positively correlated with acetylcholinesterase activity and resistance level. Determining the genomic structure of the duplicated region revealed that, in both types of duplication, ace-1 and 11 other genes formed tandem 203kb amplicons. We developed a diagnostic test for duplications, which showed that ace-1 was amplified in all 173 resistant mosquitoes analyzed (field-collected in several African countries), in heterogeneous or homogeneous duplications. Each type was associated with different fitness trade-offs: heterogeneous duplications conferred an intermediate phenotype (lower resistance and fitness costs), whereas homogeneous duplications tended to increase both resistance and fitness cost, in a complex manner. The type of duplication selected seemed thus to depend on the intensity and distribution of selection pressures. This versatility of trade-offs available through gene duplication highlights the importance of large mutation events in adaptation to environmental variation. This impressive adaptability could have a major impact on vector control in Africa.

Abstract

An ace-1 gene duplication resorbs the fitness cost associated with resistance in Anopheles gambiae, the main malaria mosquito. (2015) (https://pubmed.ncbi.nlm.nih.gov/26434951)

Additional References

RELATED GEPHE

3 (para (kdr), resistance to dieldrin, SAP-2) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^7165^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title)

Related Genes

3 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^Acetylcholinesterase (Ace-1)^/and+Taxon ID=^7165^/or+Gene Gephebase=^Acetylcholinesterase (Ace-1)^/and+Taxon ID=^7165^#gephebase-summary-title)

Related Haplotypes

EXTERNAL LINKS

COMMENTS

@GxE - this duplication probably results from an unequal crossing-over in a heterozygote R/S