

GEPHE SUMMARY

	Gephebase Gene	GephelD
Acetylcholinesterase (Ace-1) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^Acetylcholinesterase (Ace-1)^#gephebase-summary-title)	GP00001374	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) (https://www.gephebase.org/search-criteria?/and+Trait criteria?/and+Trait=^Xenobiotic resistance (insecticide)^#gephebase-summary-title)

Trait State in Taxon A
Anopheles gambiae Mosquitoes- AcerKisR3 ; more resistant to OP and CX insecticides ; much lower viability and fertility than wildtype

Trait State in Taxon B
Anopheles gambiae Mosquitoes- Baguida and derived AgRR5 ; much more resistant ; slightly lower viability and fertility than AcerKisR3

Ancestral State
Taxon A

Taxonomic Status
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intraspecific^#gephebase-summary-title)

Taxon A	Latin Name	Taxon B	Latin Name
Anopheles gambiae (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Anopheles+gambiae^#gephebase-summary-title)		Anopheles gambiae (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Anopheles+gambiae^#gephebase-summary-title)	

African malaria mosquito	Common Name	Taxon B	Common Name
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	Taxon A	Taxon B
species		

Lineage	Taxon A	Taxon B
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	Taxon A	Taxon B
gambiae species complex () - (Rank: no rank) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 44542)		

NCBI Taxonomy ID	Taxon A	Taxon B
7165 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7165)		

is Taxon A an Infraspecies?	Taxon A Description	Taxon B
Yes	Anopheles gambiae Mosquitoes- AcerKisR3 ; more resistant to OP and CX insecticides ; much lower viability and fertility than wildtype	

Taxon A Description	Taxon B
Anopheles gambiae Mosquitoes- Baguida and derived AgRR5 ; much more resistant ; slightly lower viability and fertility than AcerKisR3	

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	0

String	Sequence Similarities
7227.FBpp0289713 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier= 7227.FBpp0289713)	Belongs to the type-B carboxylesterase/lipase family.

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>)

Presumptive Null

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

Molecular Type

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

Aberration Type

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

Insertion Size

>1 Mb

Molecular Details of the Mutation

Strict tandem 5 times duplication of 203kb encompassing 12 genes - ace1 homogeneous gene duplications (all 5 copies S119 resistant)

Experimental Evidence

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

Main Reference

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/>)

Authors

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Abstract

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.

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

Related Haplotypes

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](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))

EXTERNAL LINKS

COMMENTS

