GEPHE SUMMARY

Gephebase Gene
str-217 (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^str-217^#gephebase-summary-title)

GepheID
GP00001783

Entry Status
Published

Main curator
Courtier

PHENOTYPIC CHANGE

Trait Category
Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait
Xenobiotic resistance (insecticide; DEET) (https://www.gephebase.org/search-criteria?/and+Trait=^Xenobiotic resistance (insecticide; DEET)^#gephebase-summary-title)

Trait State in Taxon A
sensitive to DEET

Trait State in Taxon B
resistant to DEET - Hawaiian strain CB4856

Ancestral State
Taxon A

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

Taxon A

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

Common Name
-

Synonyms
roundworm; Rhabditis elegans; Caenorhabditis elegans (Maupas, 1900); Rhabditis elegans Maupas, 1900

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Nematoda; Chromadorea; Rhabditida; Rhabditina; Rhabditomorpha; Rhabditoidea; Rhabditidae; Peloderinae; Caenorhabditis

Parent
Caenorhabditis () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 6237)

NCBI Taxonomy ID
6239 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 6239)

is Taxon A an Infraspecies?
No

Taxon B

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

Common Name
-

Synonyms
roundworm; Rhabditis elegans; Caenorhabditis elegans (Maupas, 1900); Rhabditis elegans Maupas, 1900

Rank
species

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Nematoda; Chromadorea; Rhabditida; Rhabditina; Rhabditomorpha; Rhabditoidea; Rhabditidae; Peloderinae; Caenorhabditis

Parent
Caenorhabditis () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 6237)

NCBI Taxonomy ID
6239 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 6239)

is Taxon B an Infraspecies?
Yes

Taxon B Description
CB4856 (Hawaiian strain)

GENOTYPIC CHANGE

Generic Gene Name
str-217

Synonyms
CELE_Y102A5C.28; Y102A5C.28

String
-

Sequence Similarities
-

GO - Molecular Function
GO:0038022 : G protein-coupled olfactory receptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0038022)

GO - Biological Process
GO:0007186 : G protein-coupled receptor signaling pathway (https://www.ebi.ac.uk/QuickGO/term/GO:0007186)
GO:0042048 : olfactory behavior (https://www.ebi.ac.uk/QuickGO/term/GO:0042048)

GO - Cellular Component

UniProtKB Caenorhabditis elegans
Q9XX85 (http://www.uniprot.org/uniprot/Q9XX85)

GenebankID or UniProtKB Caenorhabditis elegans
Q9XX85 (https://www.ncbi.nlm.nih.gov/nuccore/Q9XX85)

GO:0005887 : integral component of plasma membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0005887)

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

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

Deletion Size

-

Molecular Details of the Mutation

deletion that leads to a predicted frame shift and early stop codon - the predicted resulting protein has only one transmembrane domain instead of the 7 transmembrane domains - 138-bp deletion in exon 2 and 3 and intervening intron according to https://www.wormbase.org/species/c_elegans/variation/WBVar02076179#02-45-3 and email from Emily Dennis from 9 March 2019

Experimental Evidence

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

Main Reference

A natural variant and engineered mutation in a GPCR promote DEET resistance in C. elegans. (2018) (https://pubmed.ncbi.nlm.nih.gov/30258230)

Authors

Dennis EJ; Dobosiewicz M; Jin X; Duvall LB; Hartman PS; Bargmann CI; Vosshall LB

Abstract

DEET (N,N-diethyl-meta-toluamide) is a synthetic chemical identified by the US Department of Agriculture in 1946 in a screen for repellents to protect soldiers from mosquito-borne diseases. Since its discovery, DEET has become the world's most widely used arthropod repellent and is effective against invertebrates separated by millions of years of evolution-including biting flies, honeybees, ticks, and land leeches. In insects, DEET acts on the olfactory system and requires the olfactory receptor co-receptor Orco, but exactly how it works remains controversial. Here we show that the nematode Caenorhabditis elegans is sensitive to DEET and use this genetically tractable animal to study the mechanism of action of this chemical. We found that DEET is not a volatile repellent, but instead interferes selectively with chemotaxis to a variety of attractant and repellent molecules. In a forward genetic screen for DEET-resistant worms, we identified a gene that encodes a single GÂ protein-coupled receptor, str-217, which is expressed in a single pair of chemosensory neurons that are responsive to DEET, called ADL neurons. Mis-expression of str-217 in another chemosensory neuron conferred responses to DEET. Engineered str-217 mutants, and a wild isolate of C. elegans that carries a str-217 deletion, are resistant to DEET. We found that DEET can interfere with behaviour by inducing an increase in average pause length during locomotion, and show that this increase in pausing requires both str-217 and ADL neurons. Finally, we demonstrated that ADL neurons are activated by DEET and that optogenetic activation of ADL neurons increased average pause length. This is consistent with the 'confusant' hypothesis, which proposes that DEET is not a simple repellent but that it instead modulates multiple olfactory pathways to scramble behavioural responses. Our results suggest a consistent motif in the effectiveness of DEET across widely divergent taxa: an effect on multiple chemosensory neurons that disrupts the pairing between odorant stimulus and behavioural response.

Additional References

RELATED GEPHE

Related Genes

3 (acetyl-CoA carboxylase (ACC), beta-tubulin (ben-1), GLC-1) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^6239^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

1 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^str-217^/and+Taxon ID=^6239^/or+Gene Gephebase=^str-217^/and+Taxon ID=^6239^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS

https://www.wormbase.org/species/c_elegans/variation/WBVar02076179#02-45-3 - other C. elegans strains carry the mutation Gln5*