Drosophila pheromones: production, perception and evolution

J.-F. Ferveur
CNRS-Université de Bourgogne, D
Tight co-adaptation between the emission and the reception of sensory signals used for sexual communication.
1- DESAT1 MUTANT PHENOTYPES
The P-Gal4 transposon is inserted in the regulatory region of \( \sigma \)
The desaturase enzyme coded by *desat1* sets a double bond.
Control male

Desat1 male

7-T

7-P

23 Lin

25 Lin

27 Lin
A simple behavioral assay to assess male discrimination of sex pheromone.

In the absence of acoustic and visual cues, the male fly uses sex pheromone for sex discrimination.
The *desat1* mutation affects the production of sex pheromones.
The **desat1** mutation affects the **perception** of sex pheromones.

- **NORMAL** pheromonal discrimination
- **NO DISCRIMINATION**
- Abnormal production of sex pheromones in mutant **desat1** flies
- Abnormal perception of sex pheromones by mutant **desat1** males
Jumping out the P-Gal4 transposon precisely allows to rescue both pheromonal phenotypes

PGal4 alters the two phenotypes
2- PLEIOTROPY OF DESAT1
Link between the two pheromonal phenotypes:
Causality or Pleiotropy?

Causality?

PHEROMONE PRODUCTION

\textbf{desat1}

PHEROMONE PERCEPTION

Pléiotropy?
The genetic dissociation of the two pheromonal phenotypes indicates that desat1 has a pleiotropic effect.
Different *desat1* regulatory regions control different pheromonal phenotypes

**Phenotypes:**
- wild-type
- mutant

**Pheromone production**

**Pheromone perception**
3- REGULATION OF DESAT1
Complex structure of the *desat1* gene

- **Transcript function**
  - Tissu-specific expression of transcripts (Q-PCR & In Situ Hybridization)

- **Regulation & expression**
  - Functionnal dissection of *cis*-regulatory regions (transgenesis)
Transcript quantification (RT-PCR)

The PGal4 mutation differentially affects desat1 transcription
Functionnal dissection of desat1 regulation

Transgenes built with different regulatory regions fused with GFP
GFP-expression driven by desat1 regulatory regions in the adult abdomen
Expression in the third antennal segment driven by the complete desat1 regulatory region
GFP-expression in the 3rd antennal segment driven by specific regulatory regions

-5209 -5097
-3381 -3199
-2707 -2589
-1228 -767
-1086 -682

- 6908

- 1367

RC

RB

RD

-670
4- CONCLUSION & PERSPECTIVE
Summary: functionnal dissection of the complex desat1 regulation

The pleiotropy of desat1 is controled by distinct regulatory sequences driving expression in tissues involved either in pheromonal production or perception.
Evolutionary hypothesis

Highly conserved coding sequence

Regulatory regions subjected to evolutionary pressure

Climatic condition

Hydrocarbon desaturation

Ecological condition

Pheromone perception

Natural selection
Short term perspective: functional rescue / over-expression of UAS-desat1

Genetic background:
- desat1 mutant  
  - RESCUE
- wild-type  
  - OVER-EXPRESSION

Pheromone production?
Pheromone perception?
CONTRIBUTORS:

François Bousquet  genetics / regulatory region dissection

Benjamin Houot  behavior and hydrocarbon analysis

Isabelle Chauvel  anatomy & histology

Stéphane Dupas  transgenesis