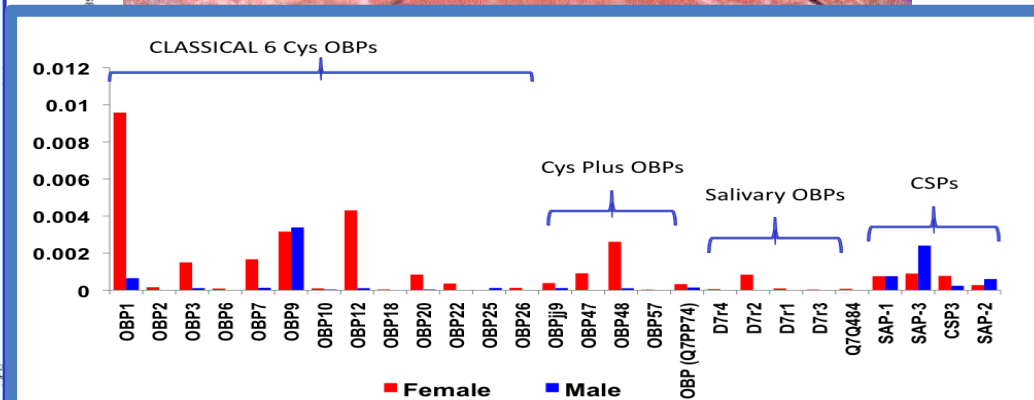
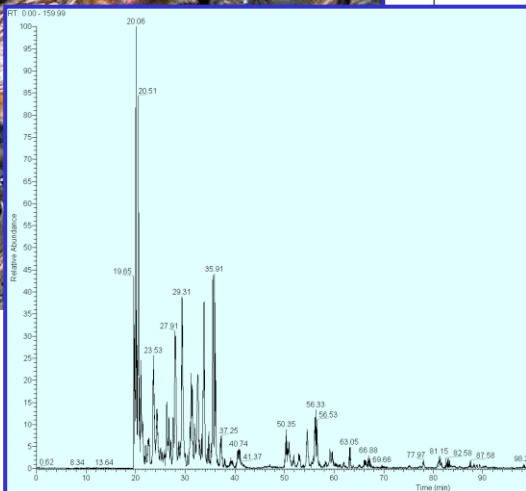
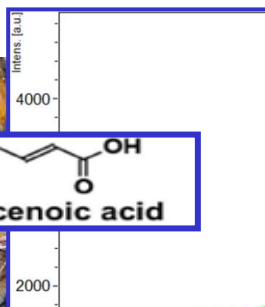
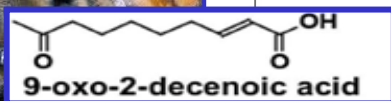


# CHEMICAL COMMUNICATION IN INSECTS, FROM PHEROMONE IDENTIFICATION TO PROTEOMICS OF OLFACTION

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**1870: Jean Henry Fabre** shows that females of the Giant Peacock Moth attract males through volatile substances



- **1959** Bombykol, the sexual pheromone produced by *Bombyx mori* females is identified by **Adolf Butenand** after 20 year work (about 500.000 females needed)



(E,Z)-10,12-esadecadien-1-olo

- In the same year **Karlson e Lüscher** introduce the term **pheromone**

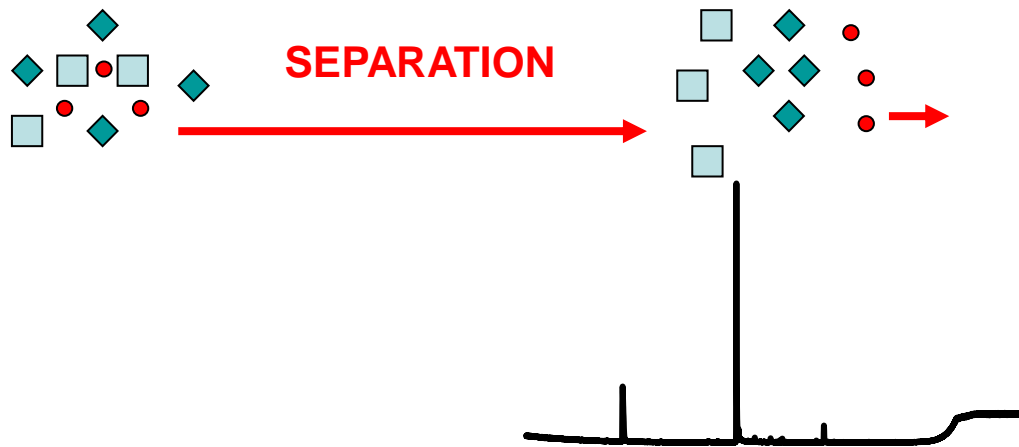
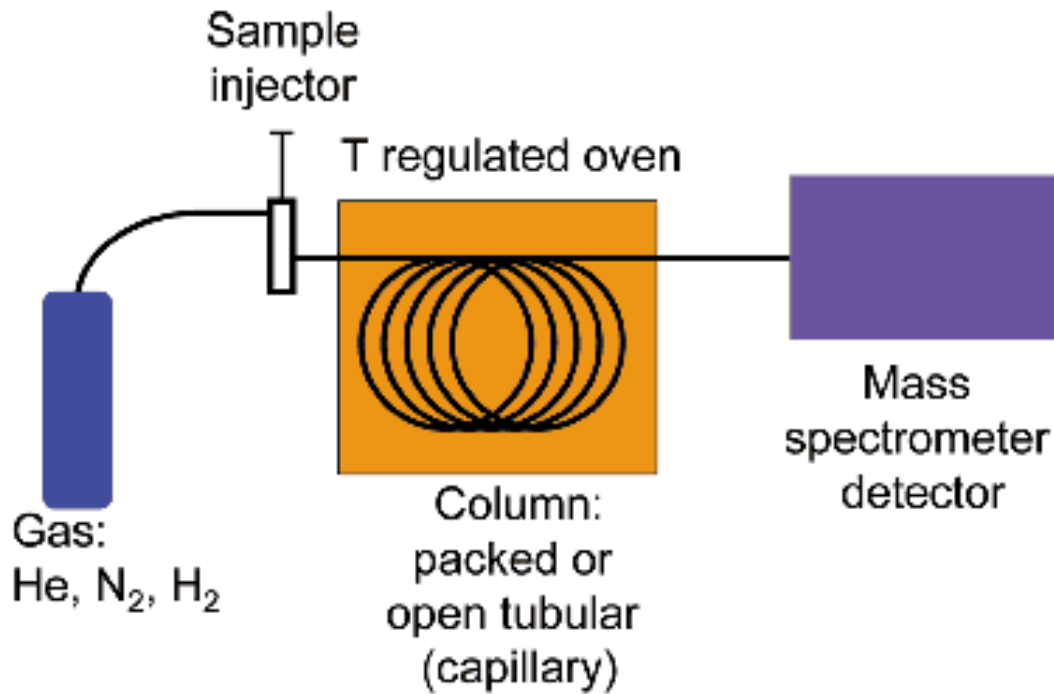


(E,Z)-10,12-esadecadienale



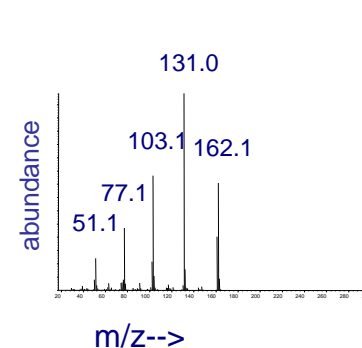
*Manduca sexta*

# Analysis of Volatiles Pheromones through Gas Chromatography coupled to Mass Spectrometry (GC-MS)



## ACQUISITION OF MASS SPECTRA

## IDENTIFICATION



# Pheromones in Terrestrial Insects

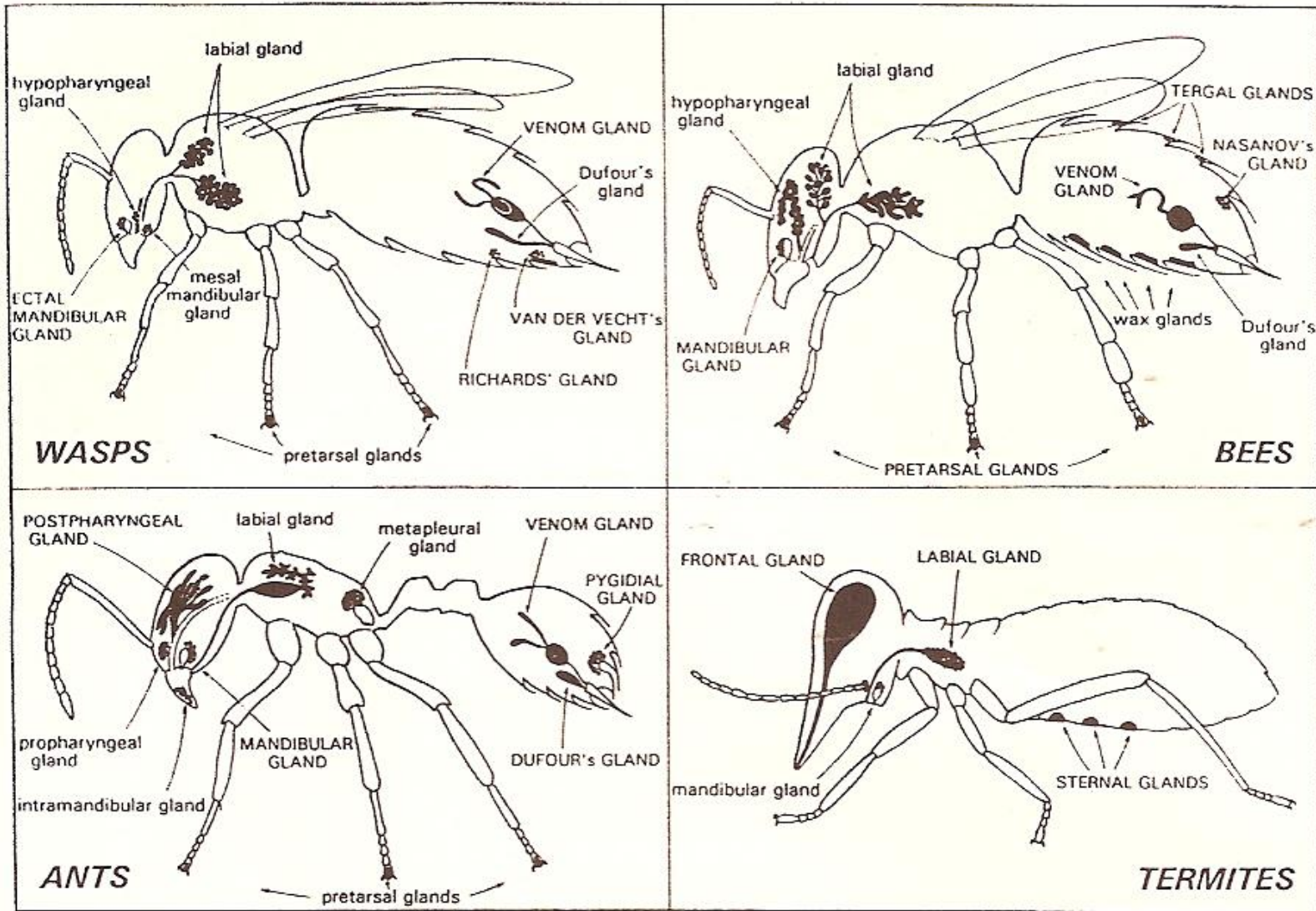
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**IN MOST CASES NON POLAR HYDROPHOBIC  
COMPUNDS**

**MOLECULAR WEIGHT of volatile pheromones up to  
300 Da**

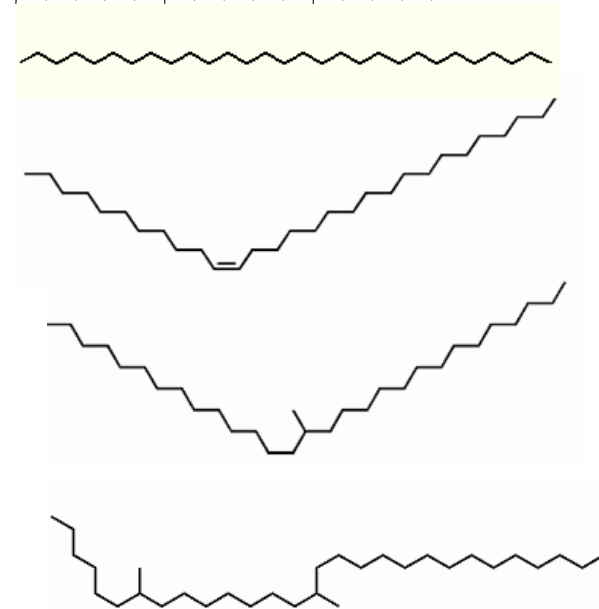
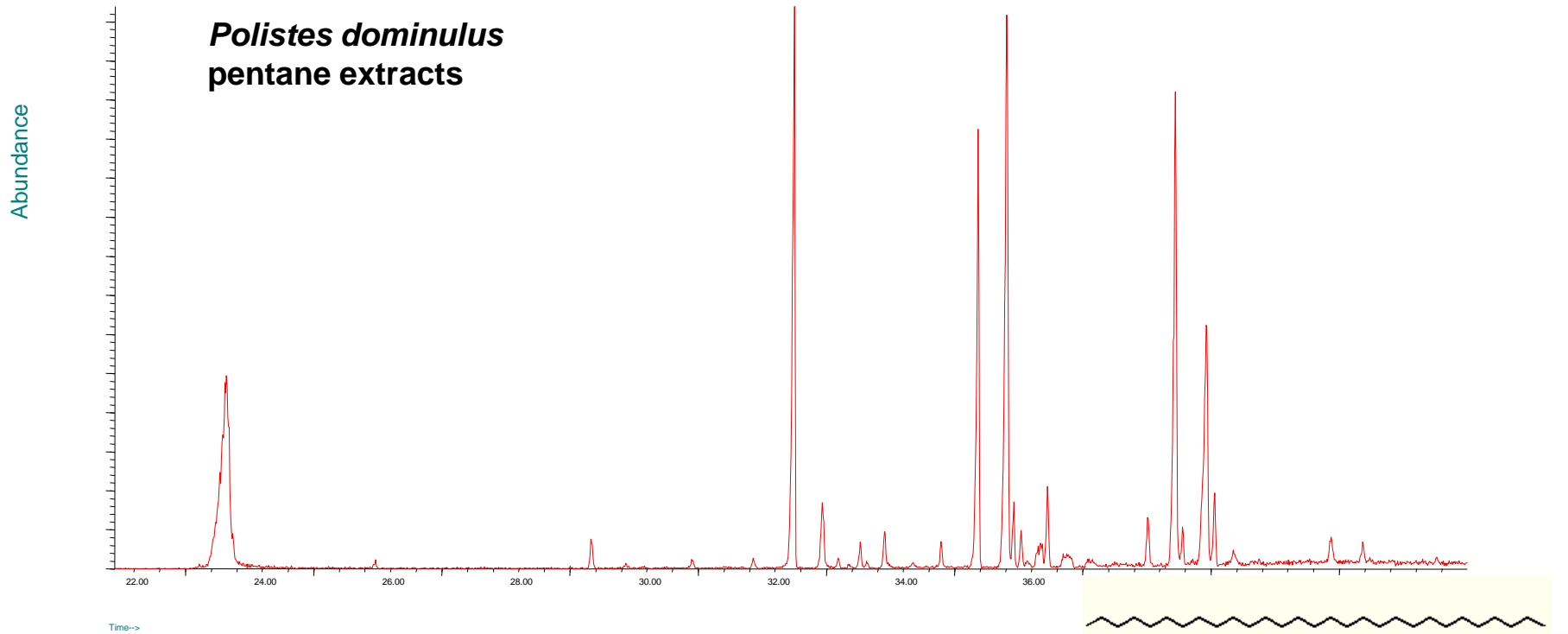
**MOLECULAR WEIGHT of contact pheromones such as  
cuticular lipids up to 280-600 Da**

# Chemical Communication has a pivotal Role in Colony Organization and Homeostasis in Social Insects



75 exocrine glands in ants, Billen, 2009

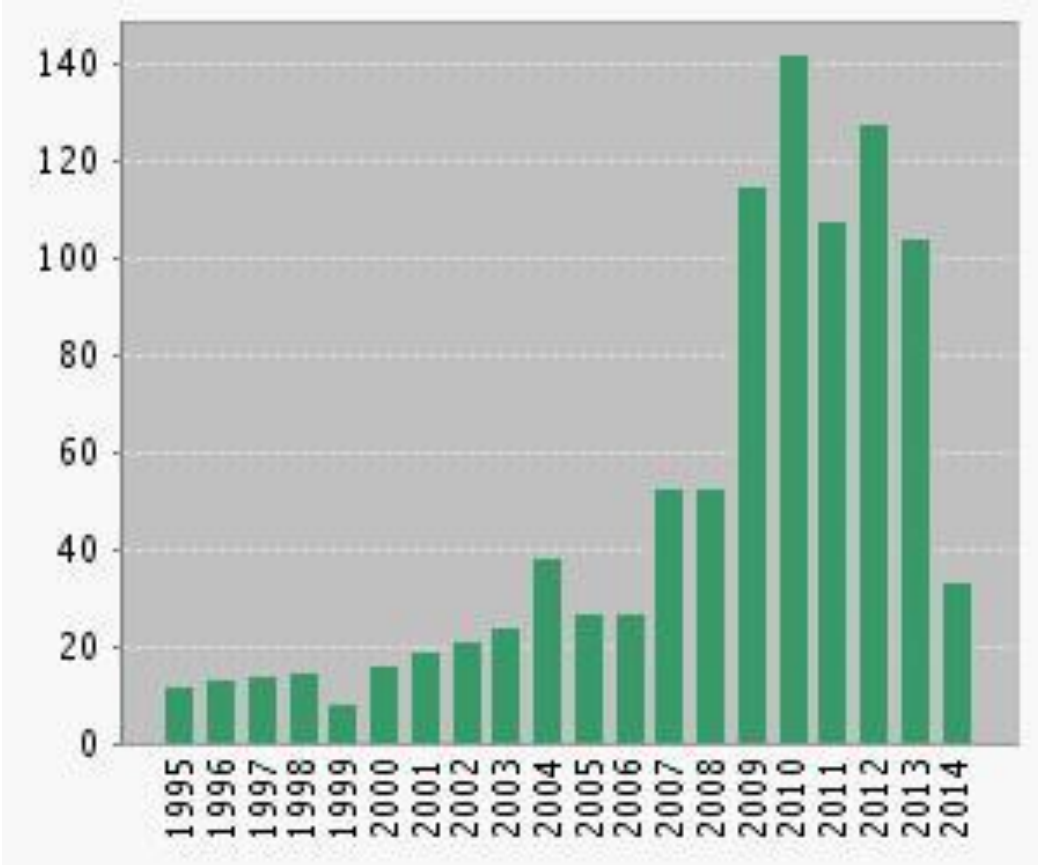
# EPICUTICULAR LIPIDS



- they prevent dehydration
- they act as recognition pheromones
- they are made of tens of compounds, mostly hydrocarbons (linear alkanes, alkenes, methyl branched alkanes)

•

# Epicuticular Hydrocarbons are recognition Pheromones in Social Insects



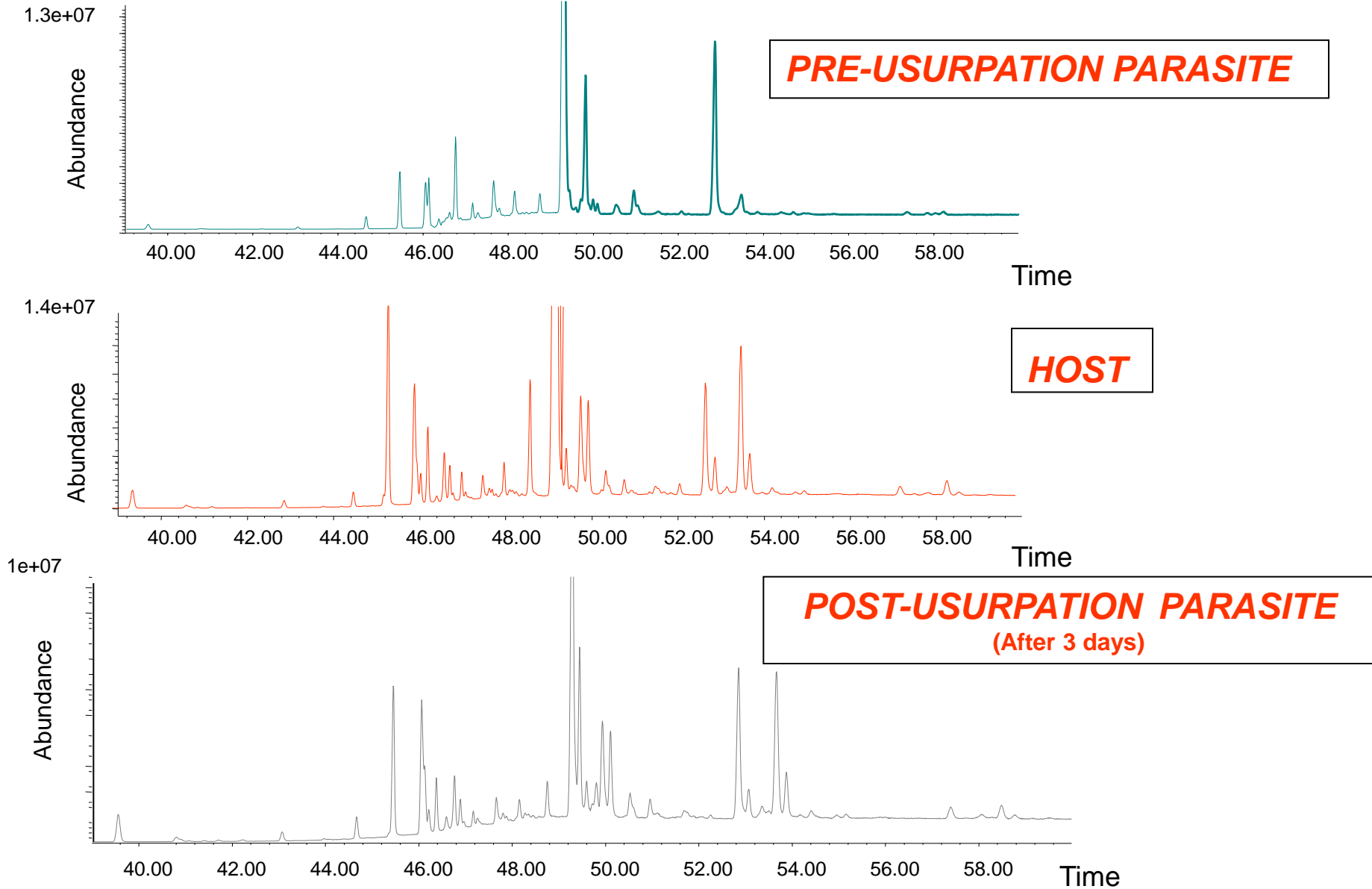
Ricerca in Web of Science per  
"Cuticular Hydrocarbons"  
AND  
"insects"



# Epicuticular Hydrocarbons in Social Parasites

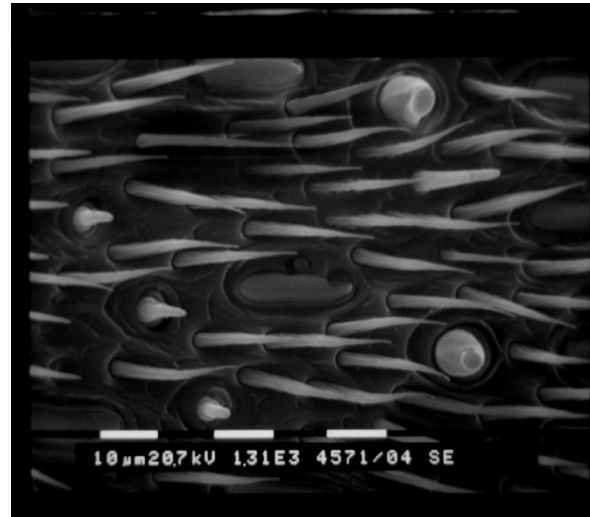
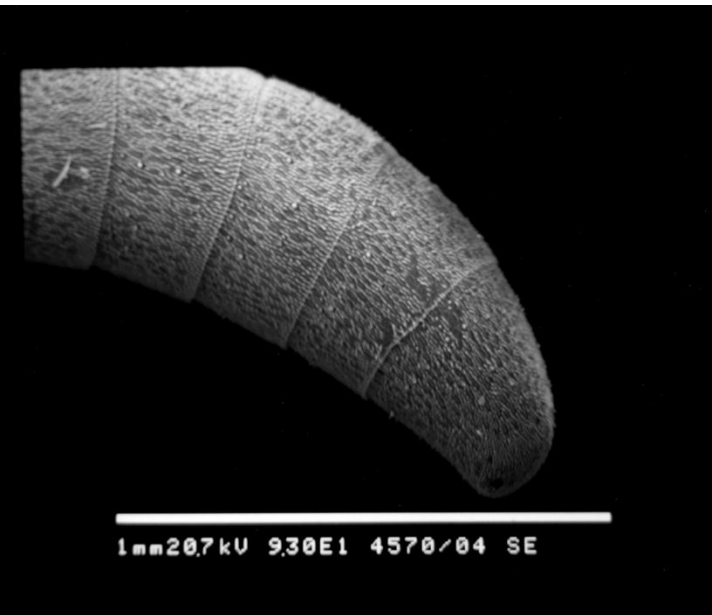


# Chemical Mimicry of the Social Parasite *P. sulcifer*

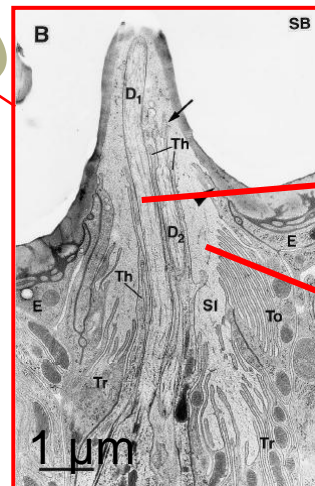
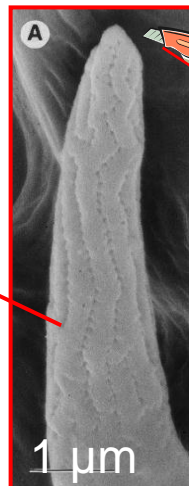


Turillazzi et al., 1999. *Naturwissenschaften*

# OLFACTORY SENSILLA



sensillar pores



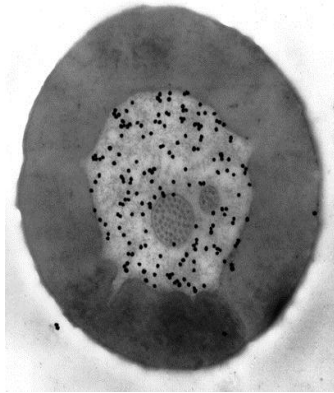
Dendrites of the olfactory receptor neuron

sensillar lymph

Shanbhag et al., 1999.

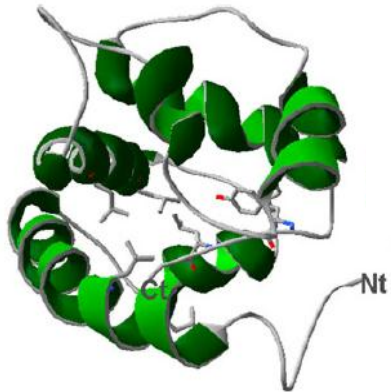
# Proteins involved in Perireceptor Events

- Highly concentrated in the sensillar lymph (10 mM for OBPs)
- Soluble proteins
- Capable of reversibly bind small molecules as odorants and pheromones
- Low molecular weight (12-35 kDa)



## ODORANT BINDING PROTEINS (OBPs)

## CHEMOSENSORY PROTEINS (CSPs)

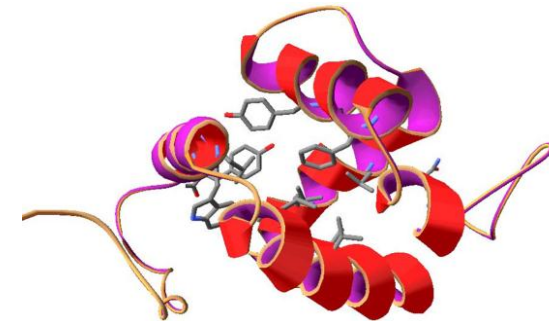


*Anopheles gambiae*  
OBP1

*Apis mellifera*: 21 OBP genes, 6 CSPs

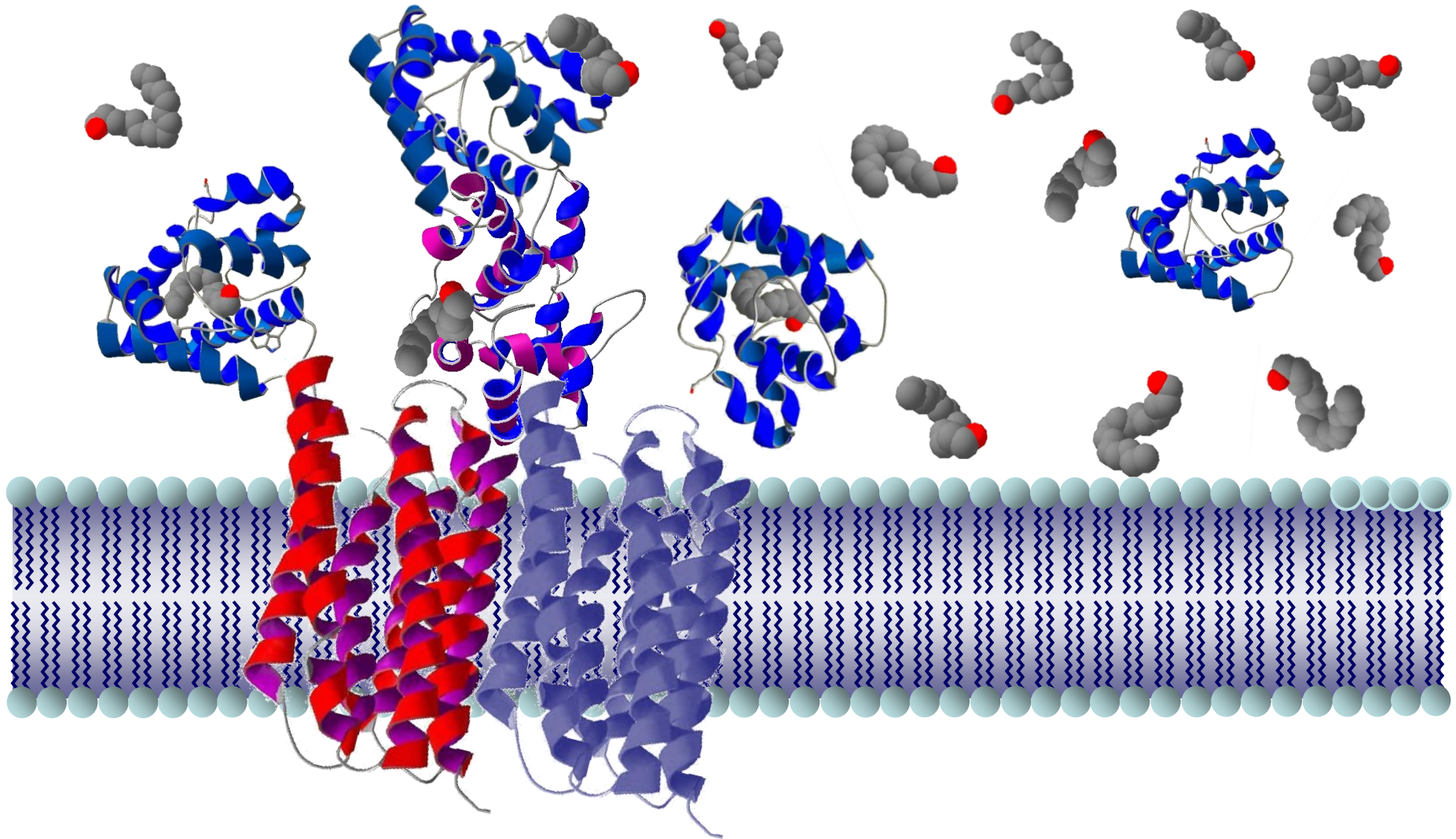
*Anopheles gambiae*: 57 OBP genes, 7 CSP genes

*Bombyx mori*: 44 OBP genes, 20 CSPs

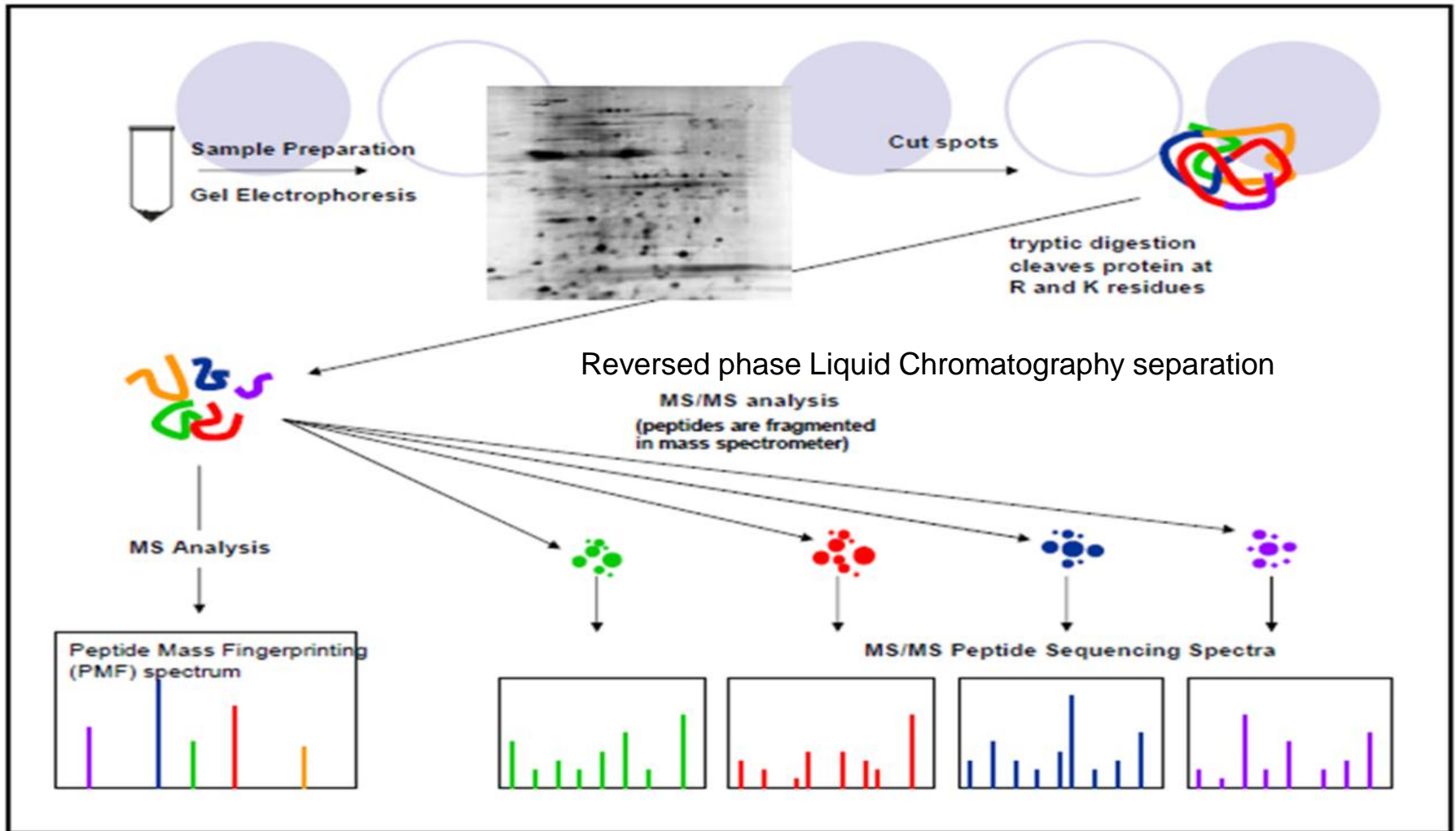


*Anopheles gambiae*  
SAP3

# Proteins involved in Perireceptor Events



# Protein Identification through MASS SPECTROMETRY (MS)

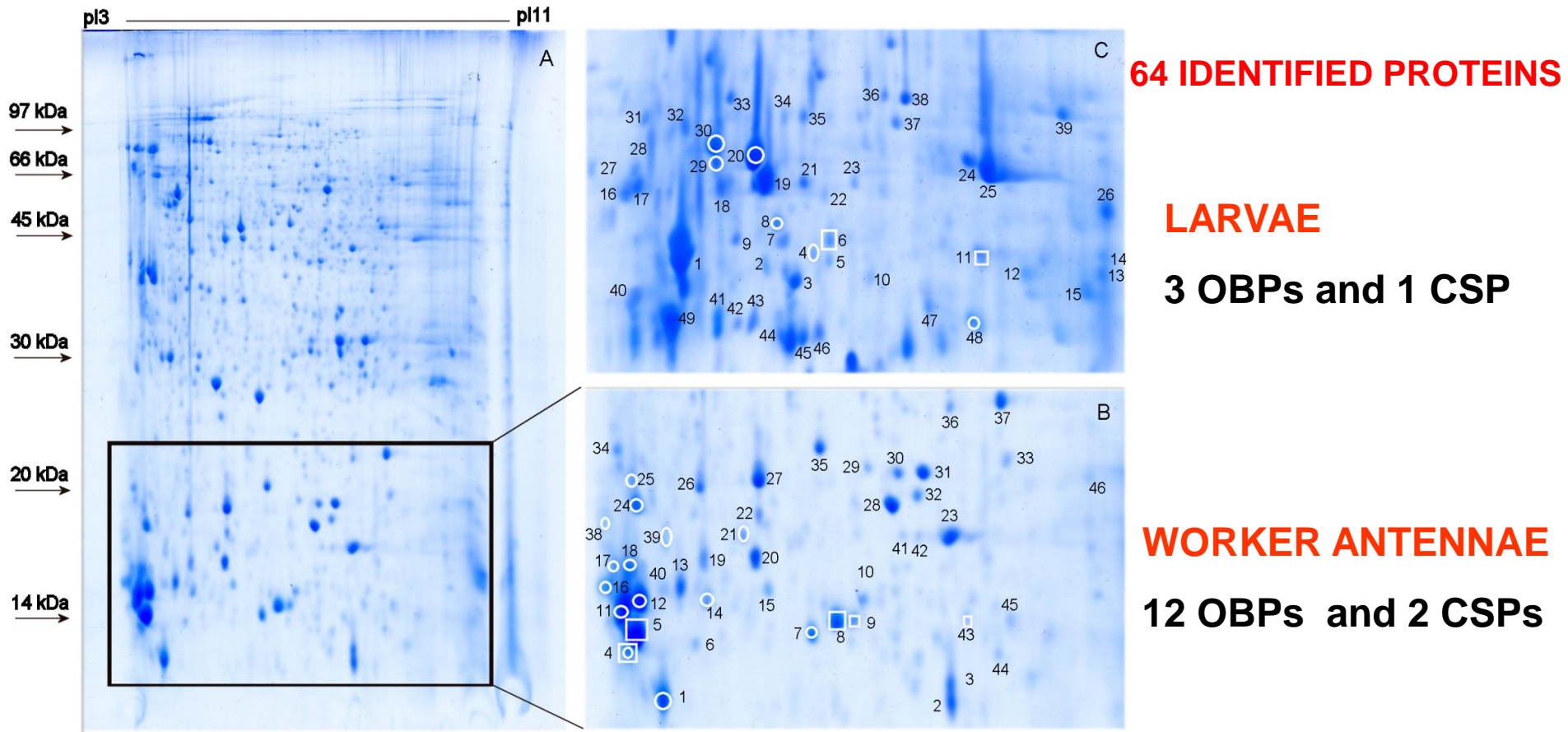


# Mapping the Expression of Soluble Olfactory Proteins in Honeybees

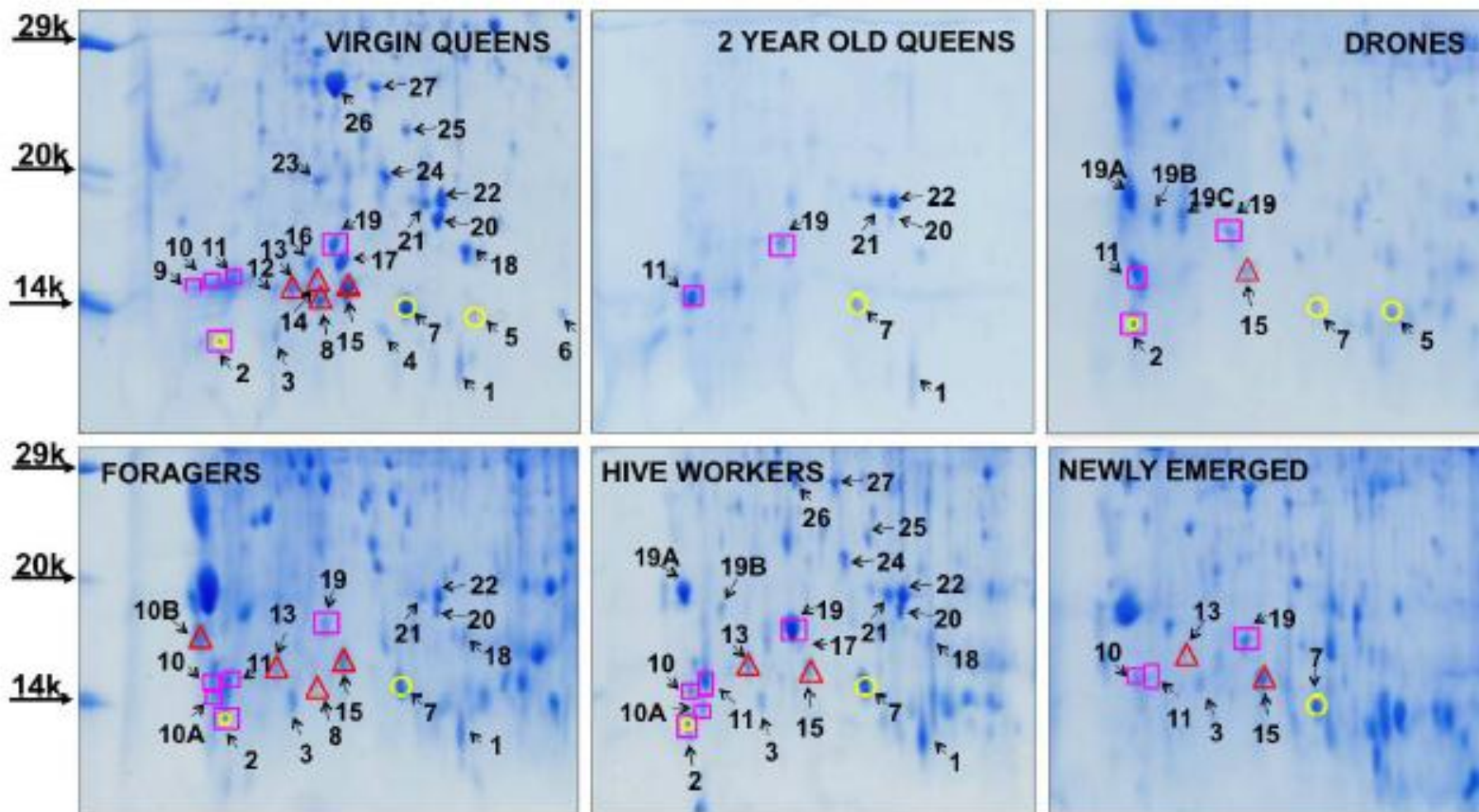
**Digestion of 2D gel spots and micro LC-ESI ORBITRAP analyses**

**21 OBP and 6 CSP genes found in the genome**

250 antennae; 10 larvae; **89 Spots digested**

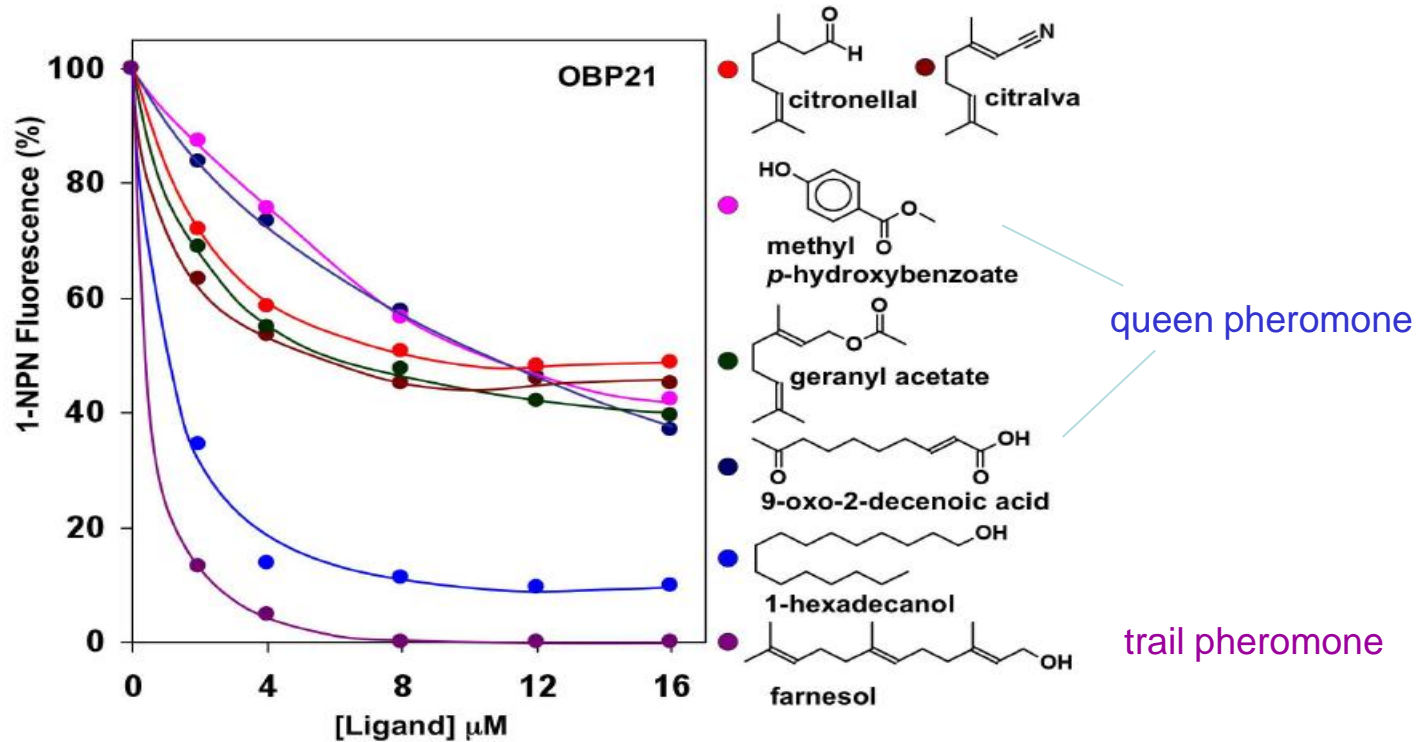


# Mapping the Expression of Soluble Olfactory Proteins in the Mandibular Gland of Honeybee

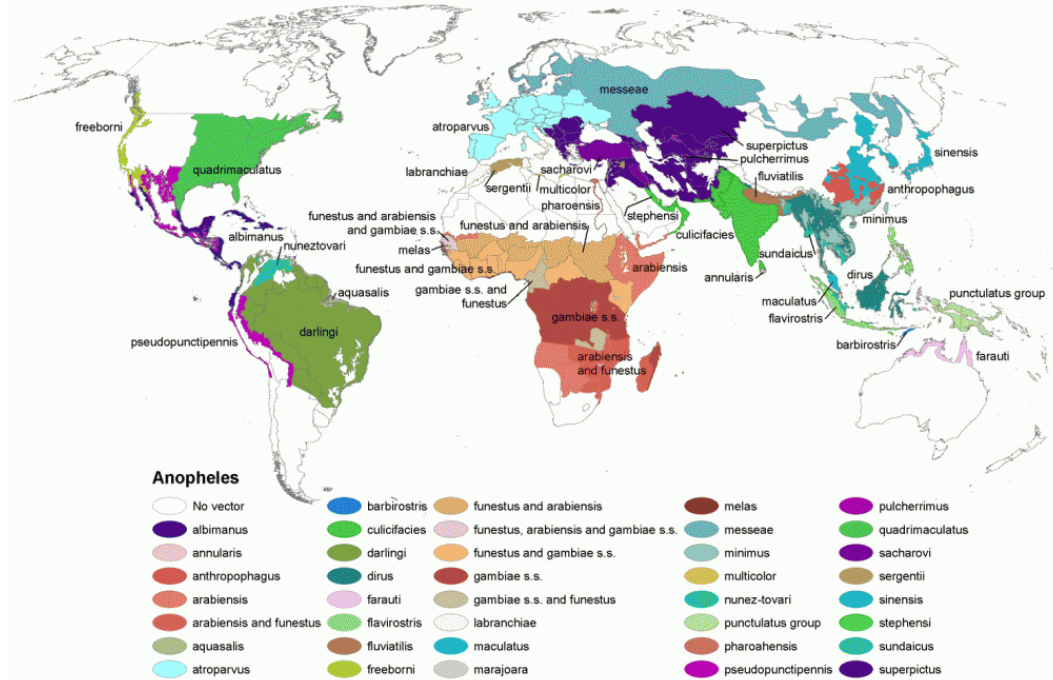




# OBPs AFFINITY FOR LIGANDS



# Olfaction in *An. gambiae*



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Available online at [www.sciencedirect.com](http://www.sciencedirect.com)



Insect Biochemistry and Molecular Biology 37 (2007) 389–398

*Insect  
Biochemistry  
and  
Molecular  
Biology*

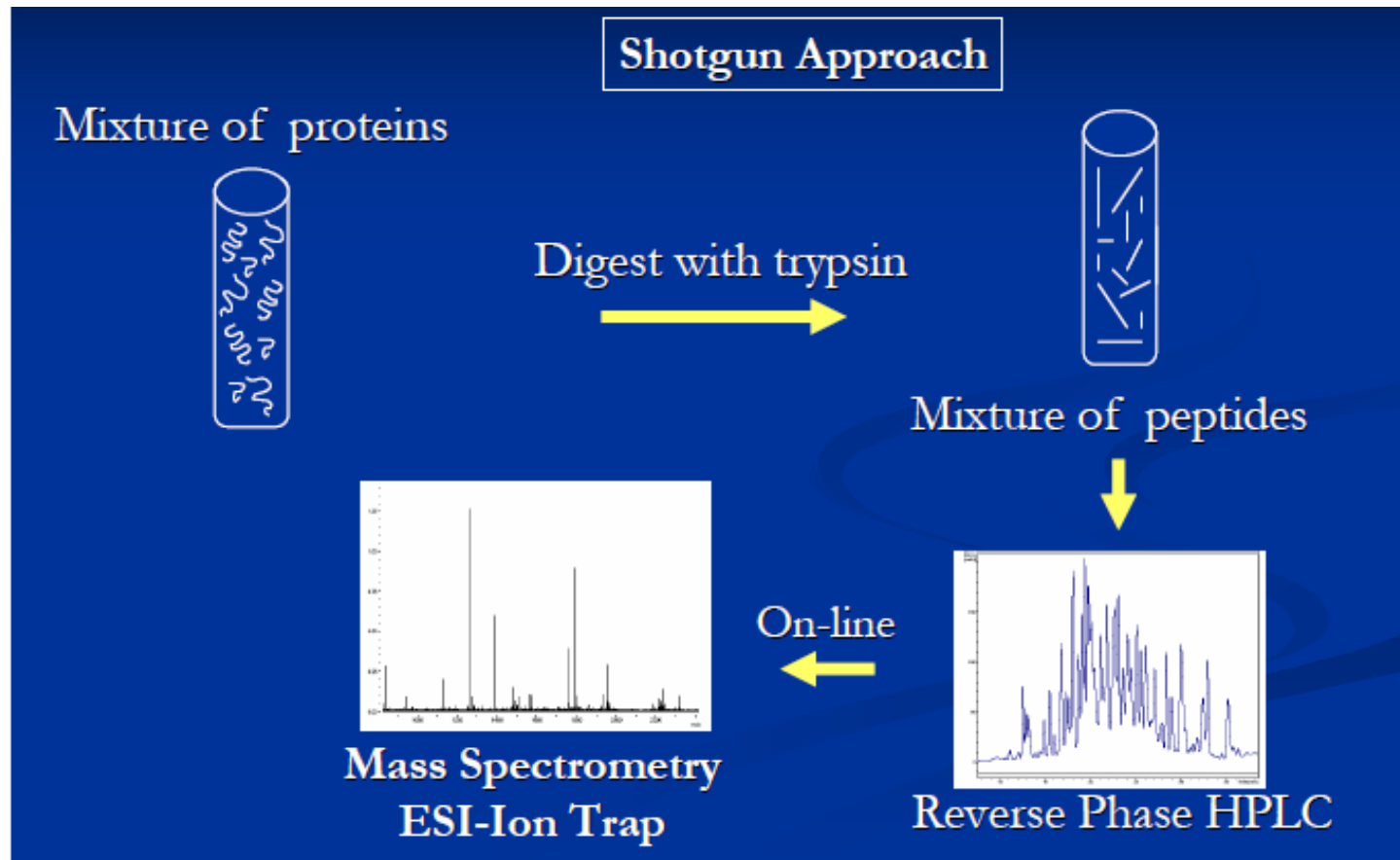
[www.elsevier.com/locate/ibmb](http://www.elsevier.com/locate/ibmb)

Comparative analysis of epicuticular lipid profiles of sympatric and allopatric field populations of *Anopheles gambiae* s.s. molecular forms and *An. arabiensis* from Burkina Faso (West Africa)

B. Caputo<sup>a</sup>, F.R. Dani<sup>b</sup>, G.L. Horne<sup>c</sup>, S. N'Fale<sup>d</sup>, A. Diabate<sup>e</sup>, S. Turillazzi<sup>b</sup>, M. Coluzzi<sup>a</sup>, C. Costantini<sup>e</sup>, A.A. Priestman<sup>c</sup>, V. Petrarca<sup>f</sup>, A. della Torre<sup>a,\*</sup>

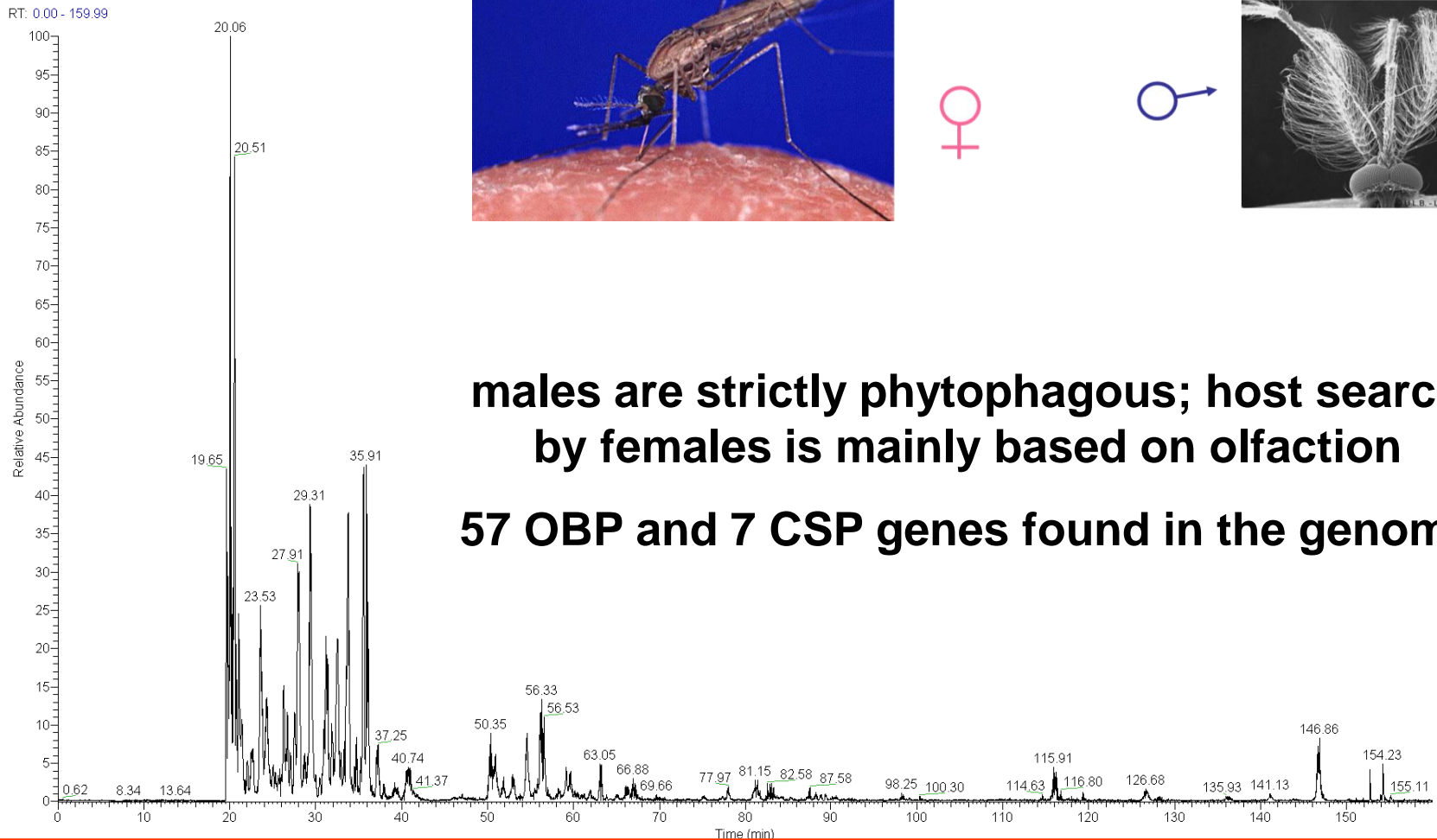
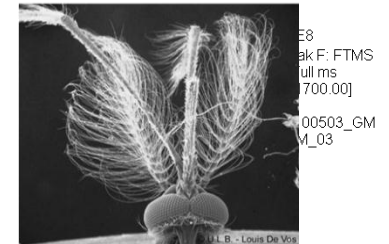
# Mapping the expression of soluble olfactory proteins in *Anopheles gambiae* through shotgun proteomics (nano HPLC-ESI ORBITRAP )

Shotgun proteomics is a method of identifying proteins in complex mixtures using a combination of high performance liquid chromatography combined with mass spectrometry



# Mapping the expression of soluble olfactory proteins in *Anopheles gambiae* through shotgun proteomics (nano HPLC-ESI ORBITRAP)

- Antenne from 600 males and from 600 females



**1333 GROUP PROTEINS IDENTIFIED; 28 OLFACTORY SOLUBLE PROTEINS**

# Mapping the expression of Soluble Olfactory Proteins in *Anopheles gambiae* through Shotgun Proteomics (nano HPLC-ESI ORBITRAP )

