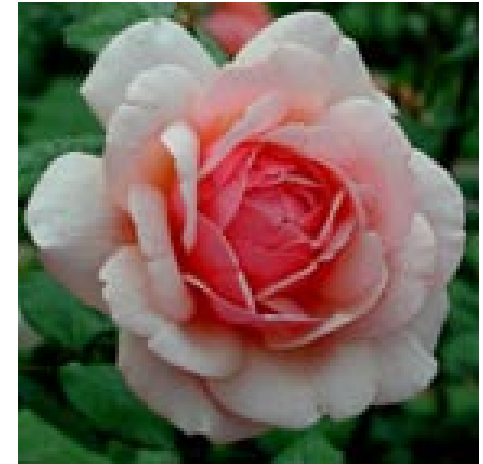


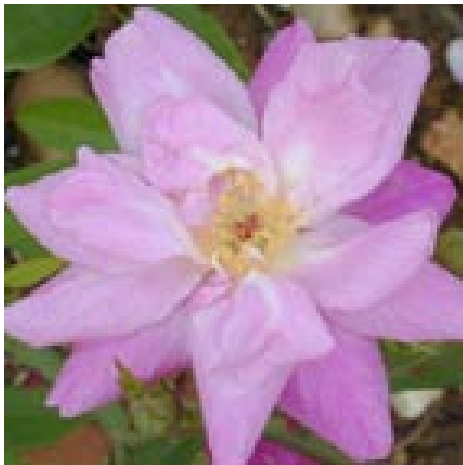


Floral Fragrances

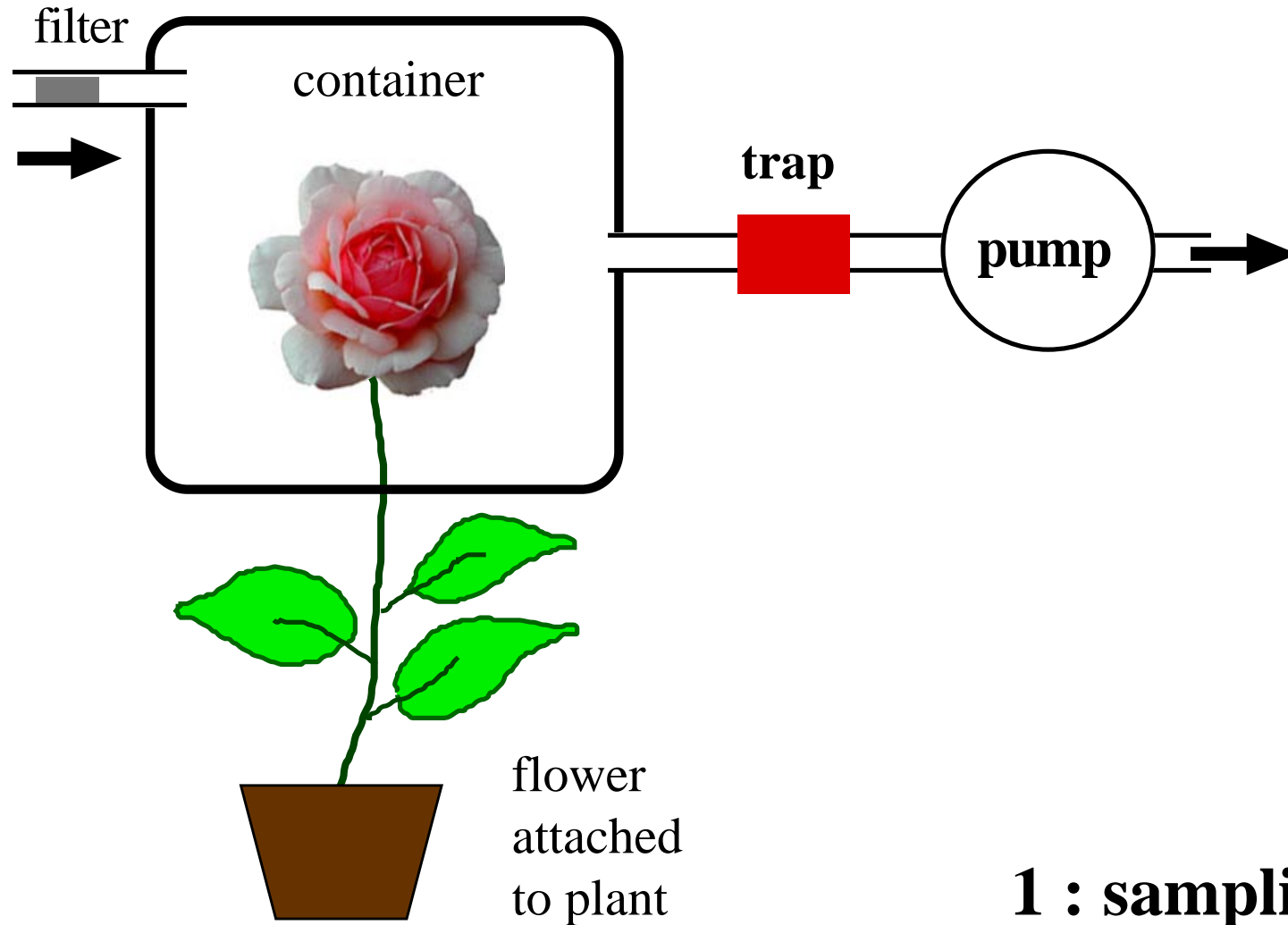
P. Hugueney, ENSL



What is flower scent ?

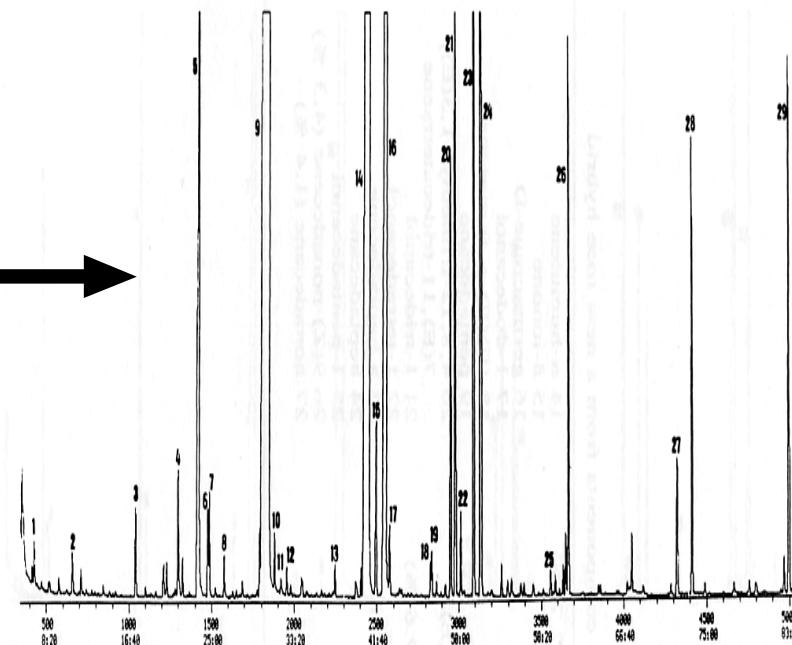


Flower scent analysis : "dynamic headspace chromatography"



Flower scent analysis using "headspace chromatography"

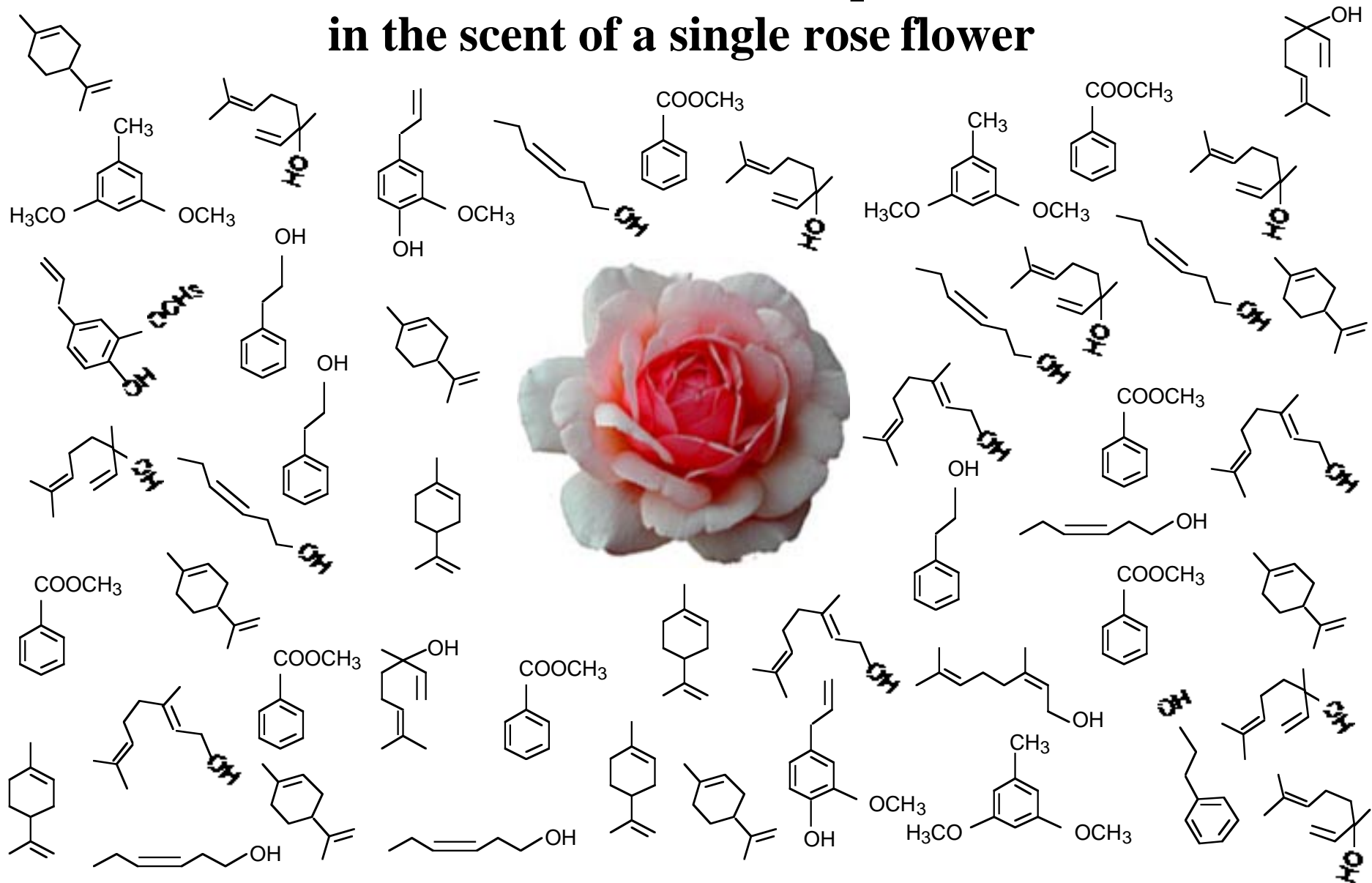
trap



Gas Chromatography
Mass Spectroscopy

2 :analysis

More than 100 different volatile compounds are detected in the scent of a single rose flower



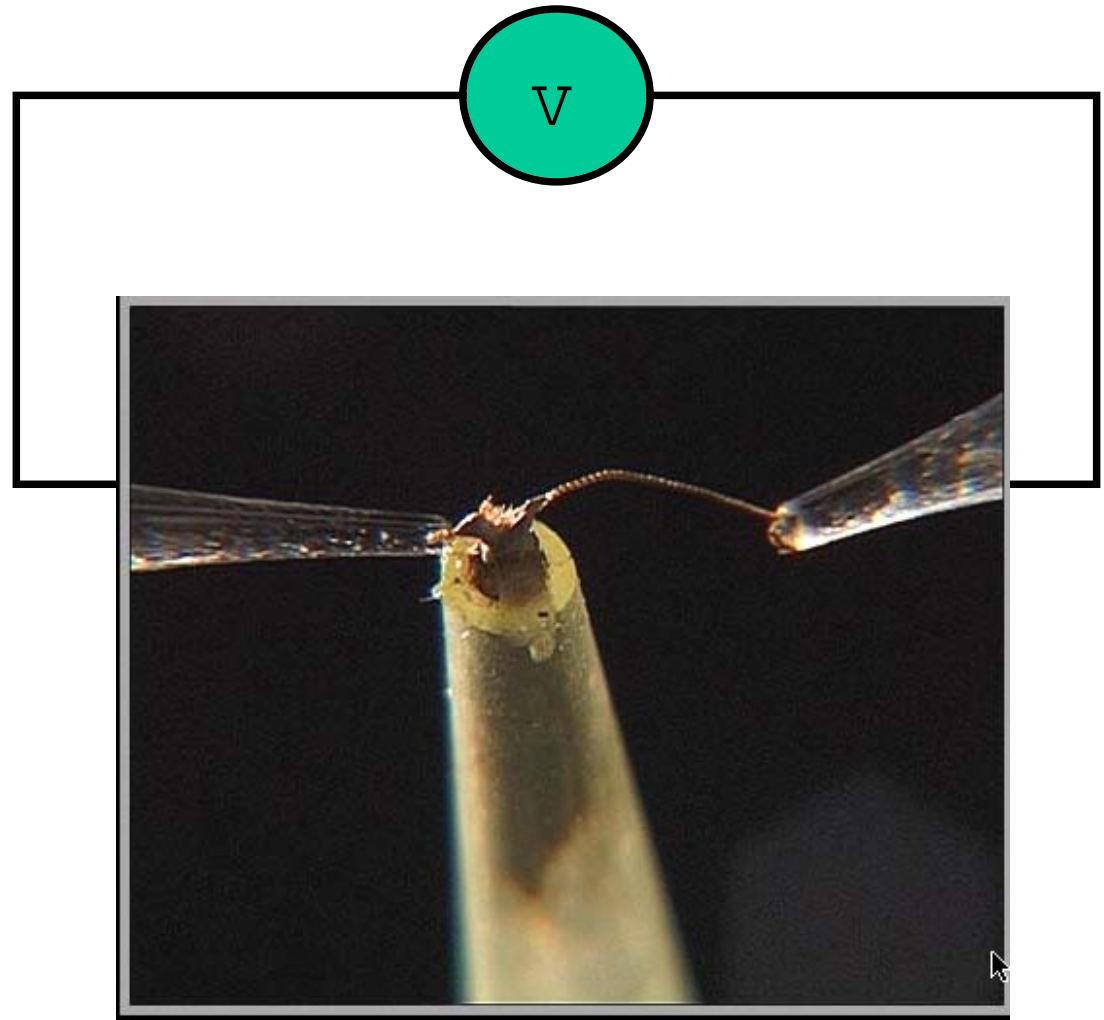
The reason why flowers are scented ...

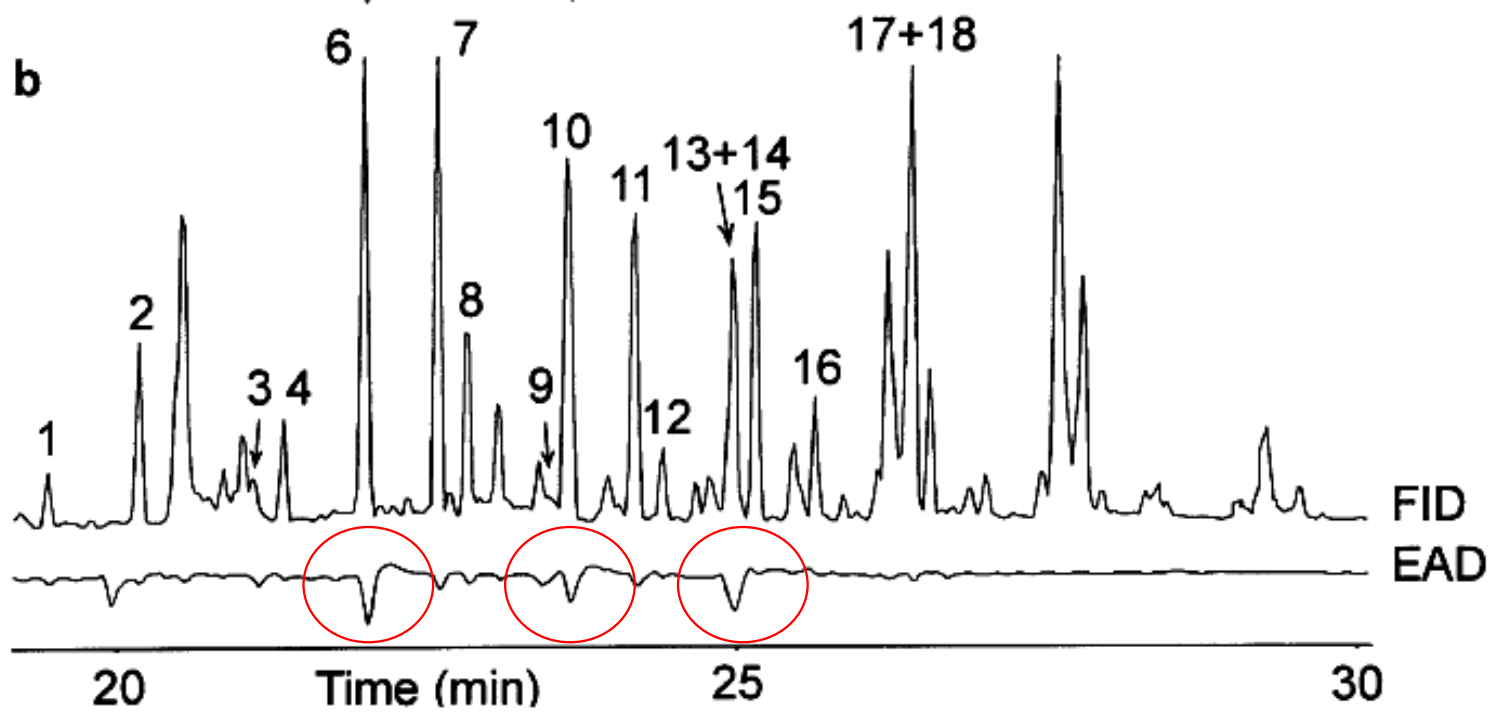
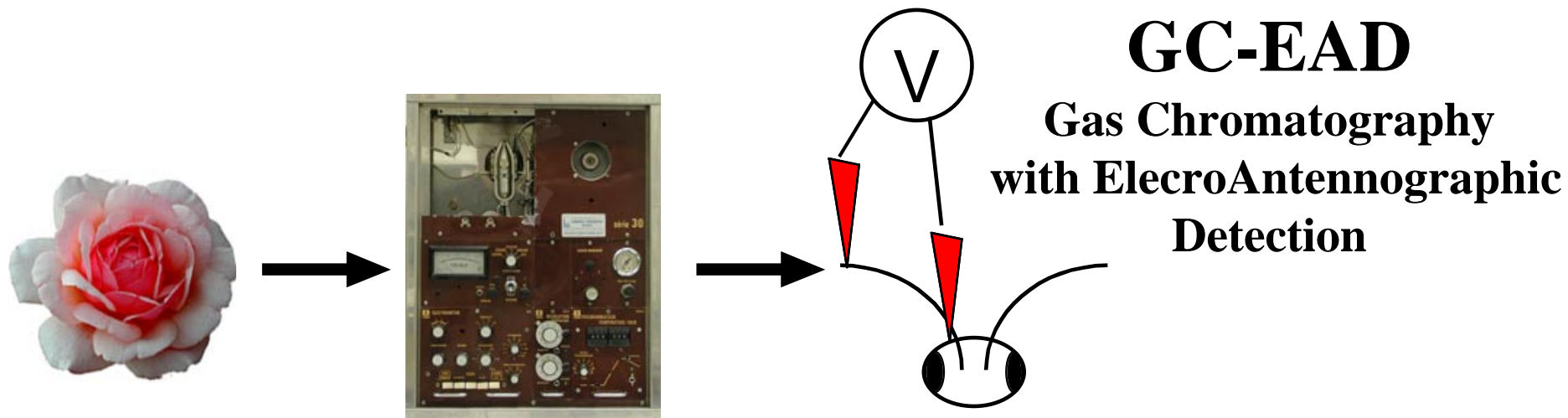


Olfactory organ of insects : the antenna

**Antenna : contains
olfactory neurons**

electroantennography :
**detection of neuron
membrane
depolarization**

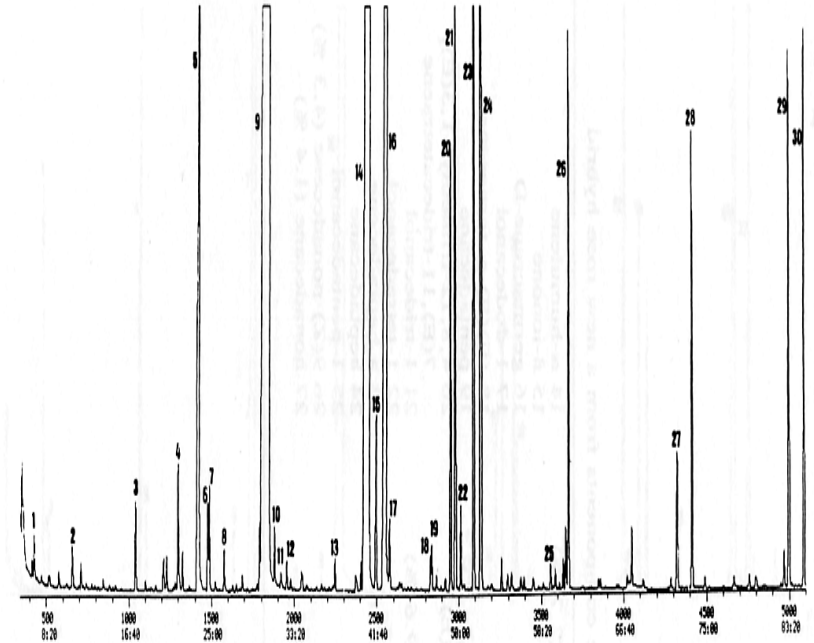




Sex pheromone mimicry in
the orchid *Ophrys sphegodes*

Schiestl *et al.* (2000), J. Comp. Physiol. A 186 : 567-574

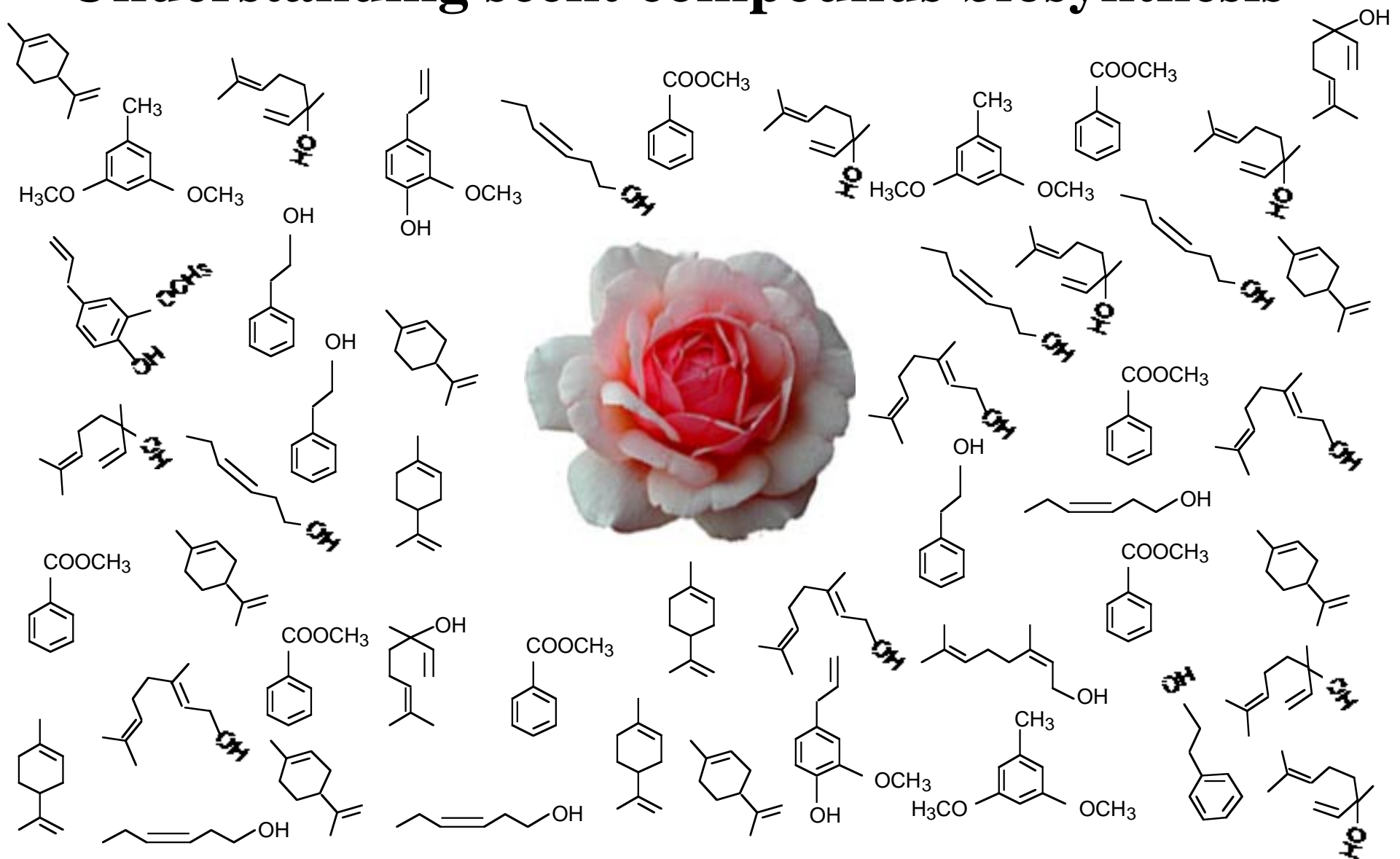
Flower scent analysis by "nose detection"



A "pleasant" scent is relative....



Understanding scent compounds biosynthesis



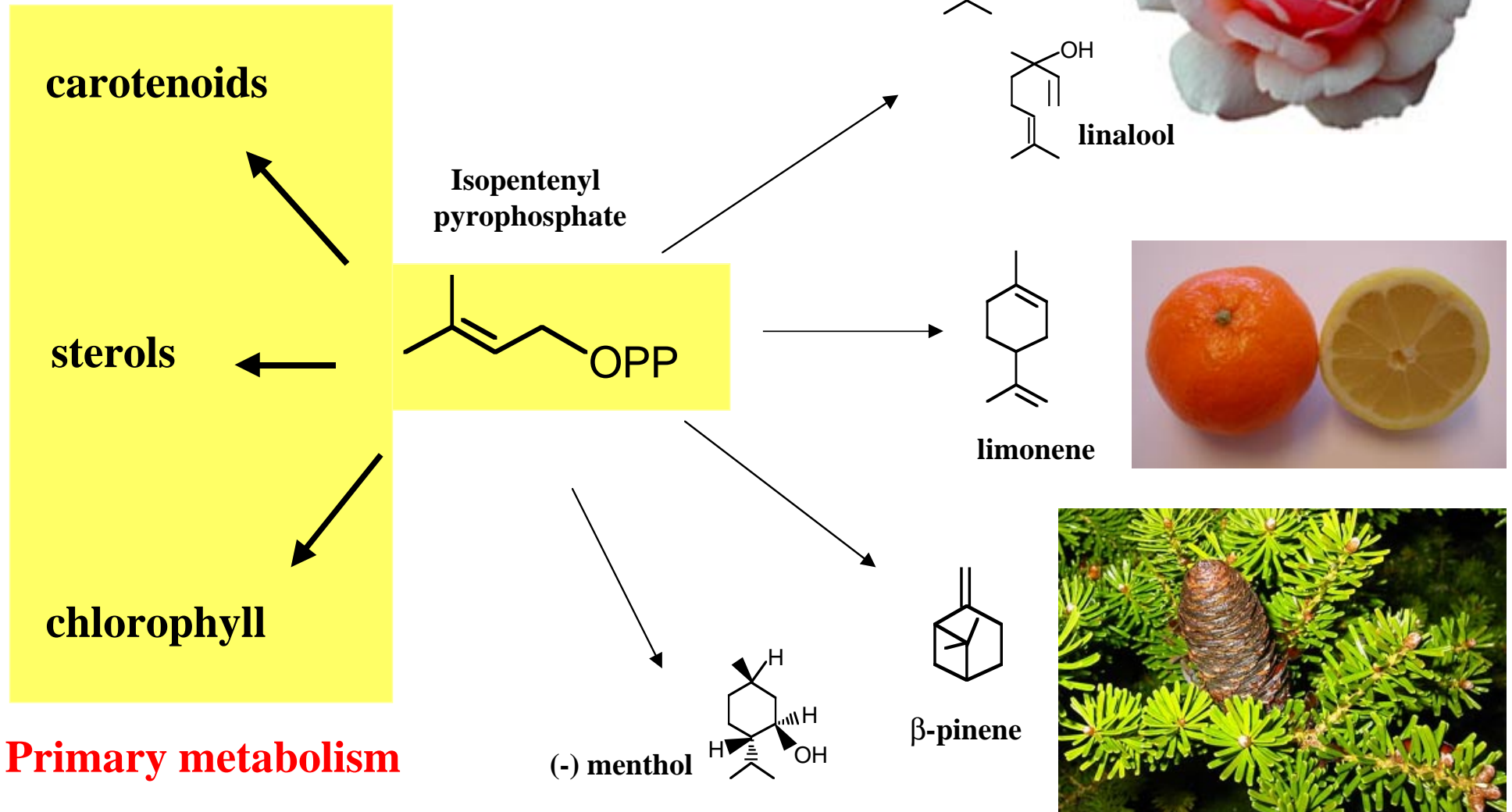
Understanding scent compounds biosynthesis

= Organizing scent compounds into metabolic pathways

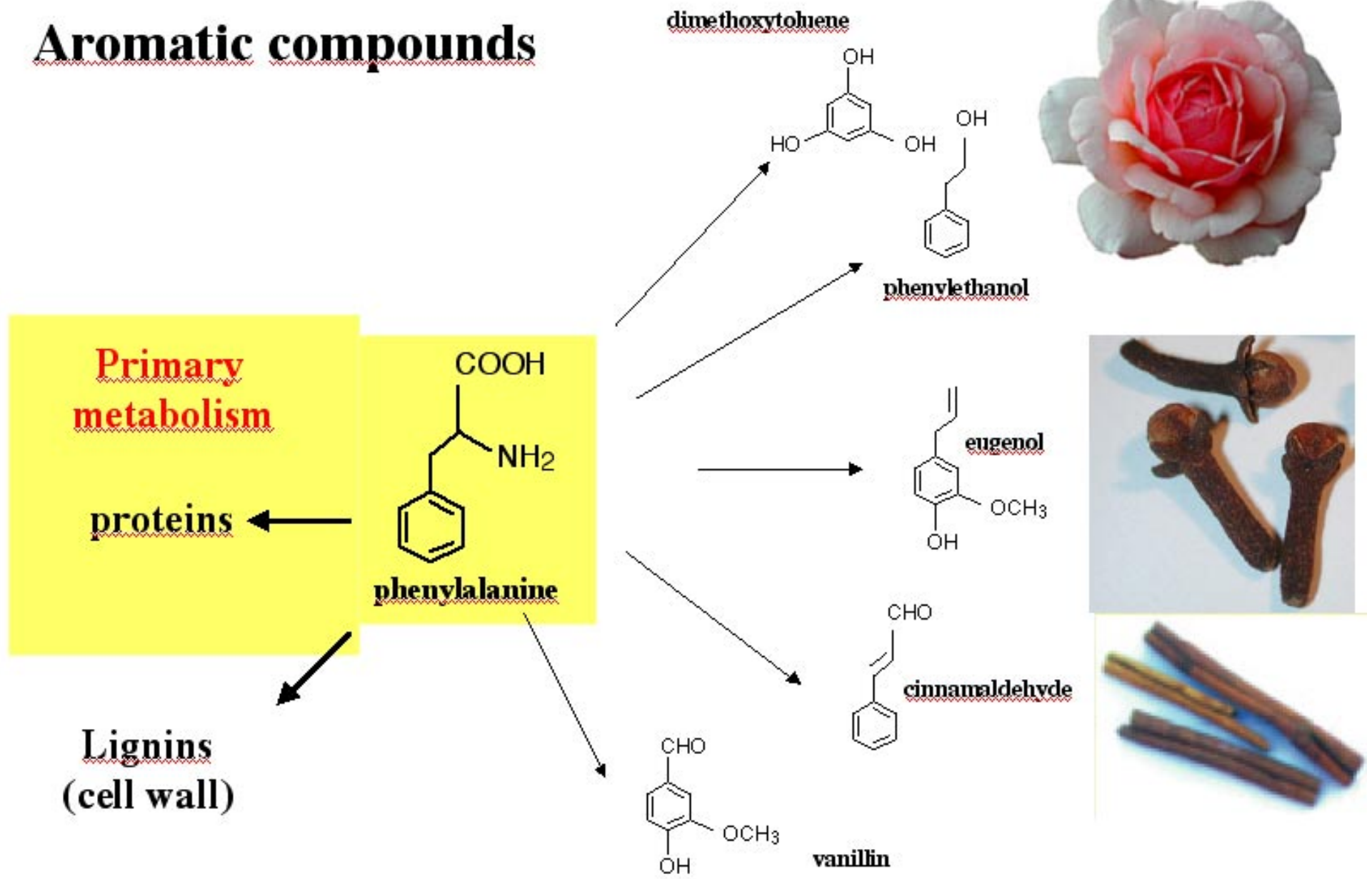
Major classes of flower scent compounds :

- Terpenes**
- Aromatic compounds**
- Fatty acid derivatives**

Terpenes (25000 natural compounds)



Aromatic compounds



Most advanced models :

- **Peppermint (*Mentha x piperata*) :**
Rodney Croteau

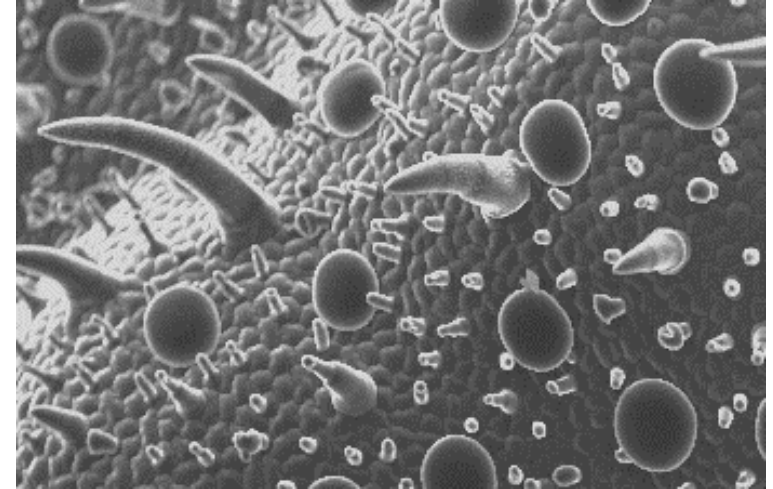


Photo : J.C. Caissard

- ***Clarkia breweri* : Eran Pichersky**
(about 10 scent genes cloned ...)



Photo :
J. D'Auria

A more recent but very promising model : the rose

***Rosa x damascena* essential oil : 15 - 20 tons oil / year**

: 1500 - 10000 €/kg

: 4 tons petals (800h) for 1kg oil

***Rosa x centifolia* (Rose de Mai)**

- grown in the south of France (Grasses)**
- 1982 : 350 tons of flowers**
- used in some perfumes**



What is a rose ?

- ***Rosa x hybrida* : initial crosses involving less than
10 wild rose species**
- **more than 2 centuries of breeding and selection**
- **about 25000 registered varieties**
- **most economically important ornamental plant**



Rosa moschata

Rosa chinensis
cv. "Old Blush"

Rosa gallica *Rosa phoenicia*

R. moschata *R. damascena*

R. bifera



R. chinensis

R. gigantea

R. gallica

R. odorata

Noisette
Roses

Bourbon
Roses

R. odorata

Yellow Tea
Roses

Pink Tea
Roses

Bourbon
Roses

Chinese
Hybrids

R. bifera

R. gallica

Portland
Roses



Tea Scented Roses

Hybrid Perpetual Roses

Hybrid Tea Roses

Modern Roses

Modern roses genealogy

Interest of crossing "European" and "Chinese" Roses

"European" Roses : ex : *Rosa gallica*, *Rosa x damascena*

- temperate climate
- yearly flowering in May



"Chinese" Roses : ex : *Rosa chinensis*

- subtropical climate
- recurrent flowering



Modern hybrid roses :

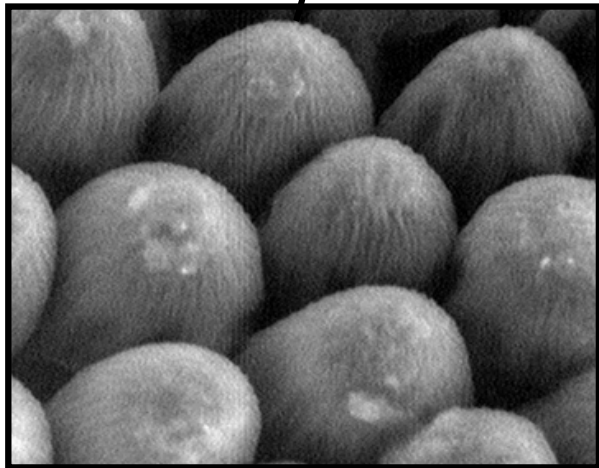
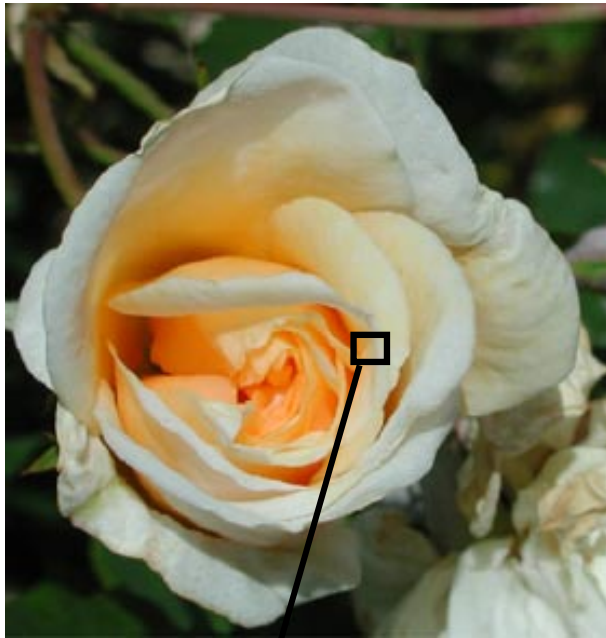
- temperate climate
- recurrent flowering
- selection of aesthetic traits



wild rose



modern rose



Secretory epidermis

Rose scent

Terpenes

Phenylethanol

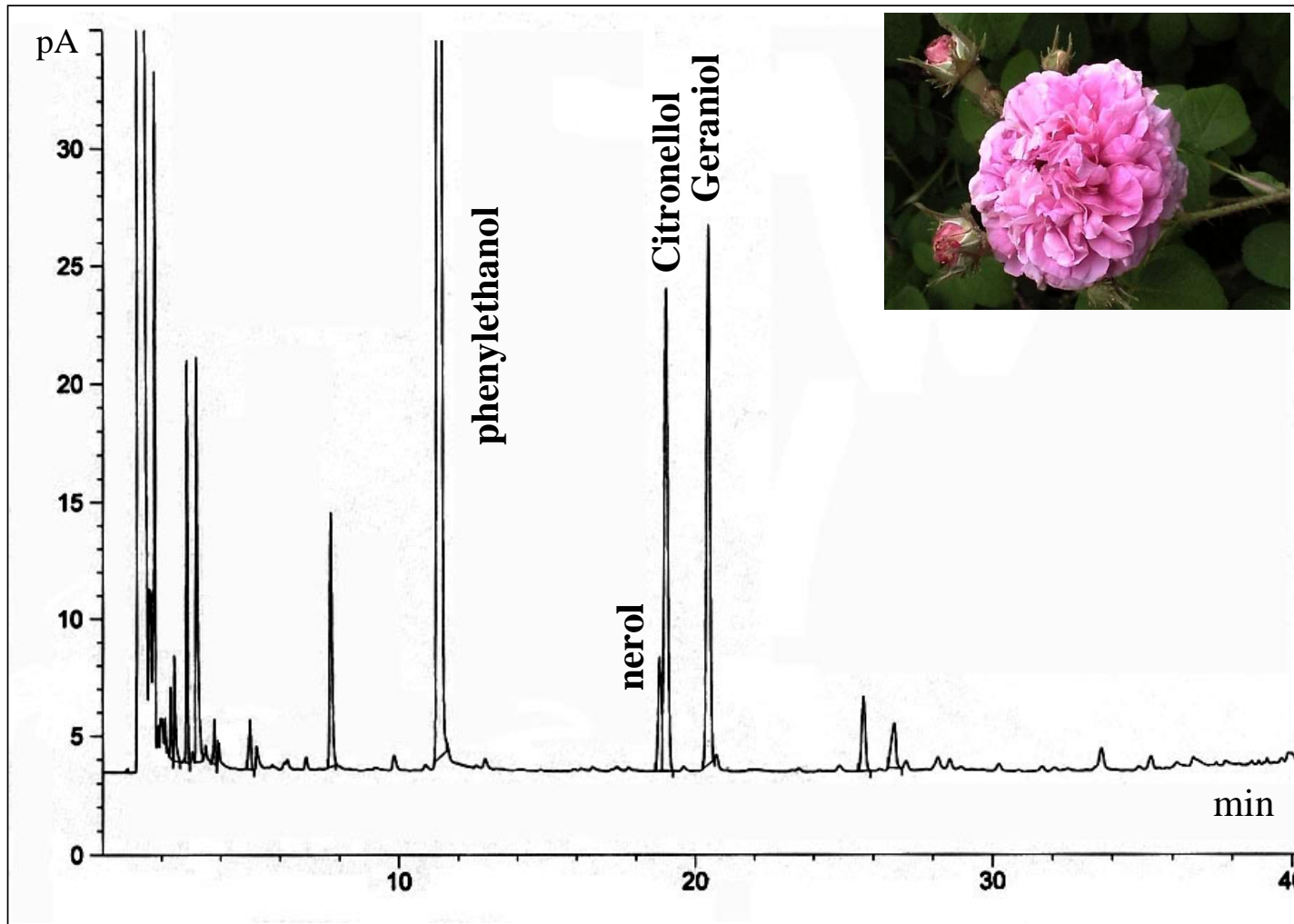
Aromatic compounds

Fatty acid derivatives

Rose ketones

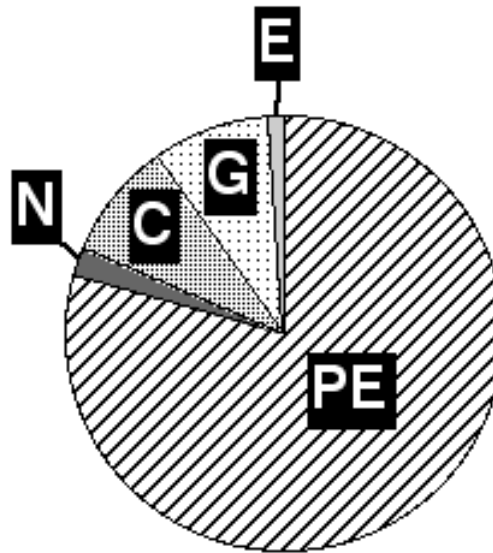
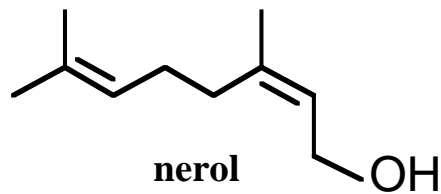
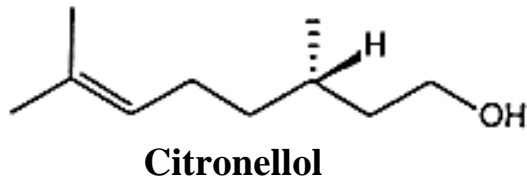
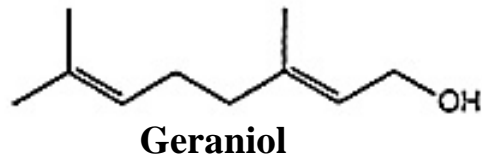
etc...

GC analysis of *R. x damascena* scent

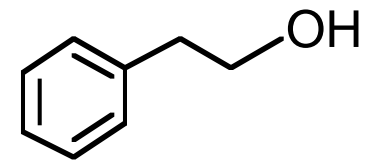


2 main types of scent in "wild" roses

"European" Type : ex : *Rosa x damascena*
- phenylethanol
- monoterpenes



R. x damascena

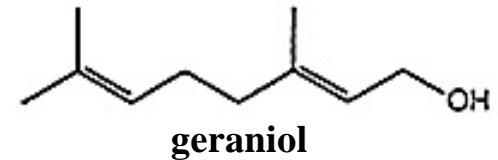
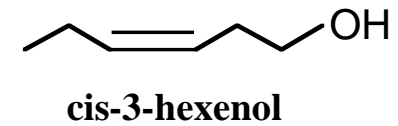
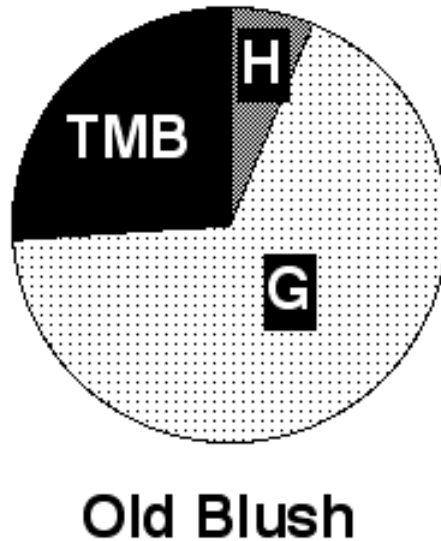
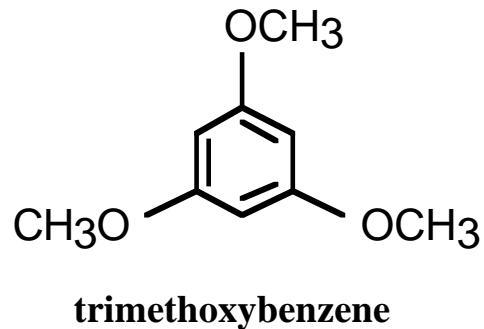


2-phenylethanol

2 main types of scent in "wild" roses

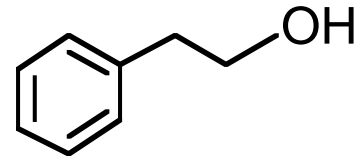
"Chinese" Type : ex : *Rosa chinensis*, *Rosa gigantea*

- monoterpenes
- fatty acid derivatives
- phenolic compounds

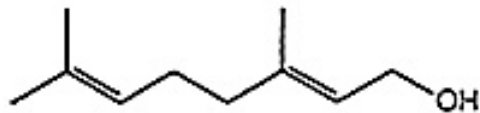


modern roses scent...

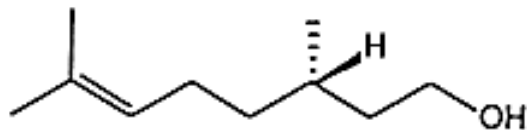
"Combined" Type :



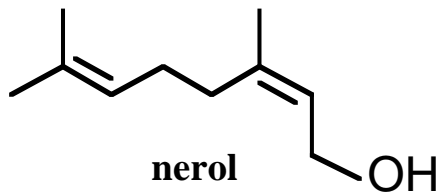
2-phenylethanol



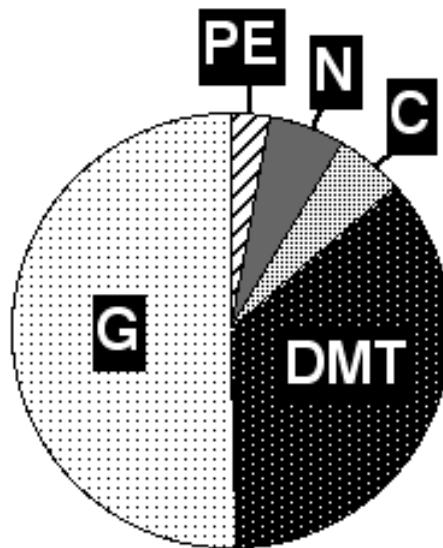
Geraniol



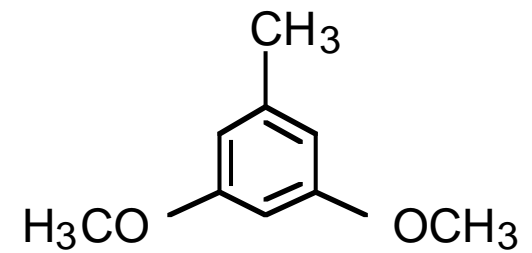
Citronellol



nerol



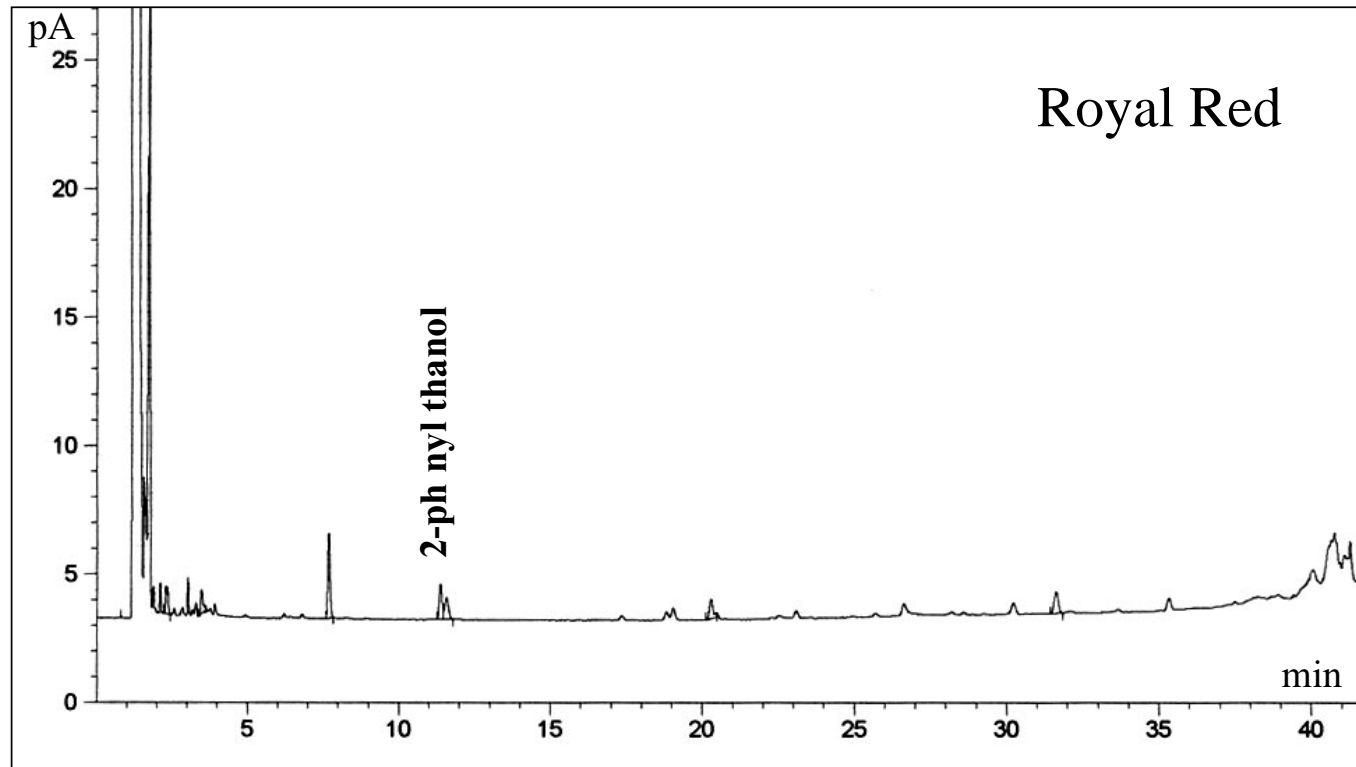
Lady Hillingdon



3,5-dimethoxytoluene

modern roses scent...

"Scentless" Type :



Why are many modern roses scentless ?



This trait was lost in recent breeding processes, with selection programs based on shape, colour, disease resistance, longevity...

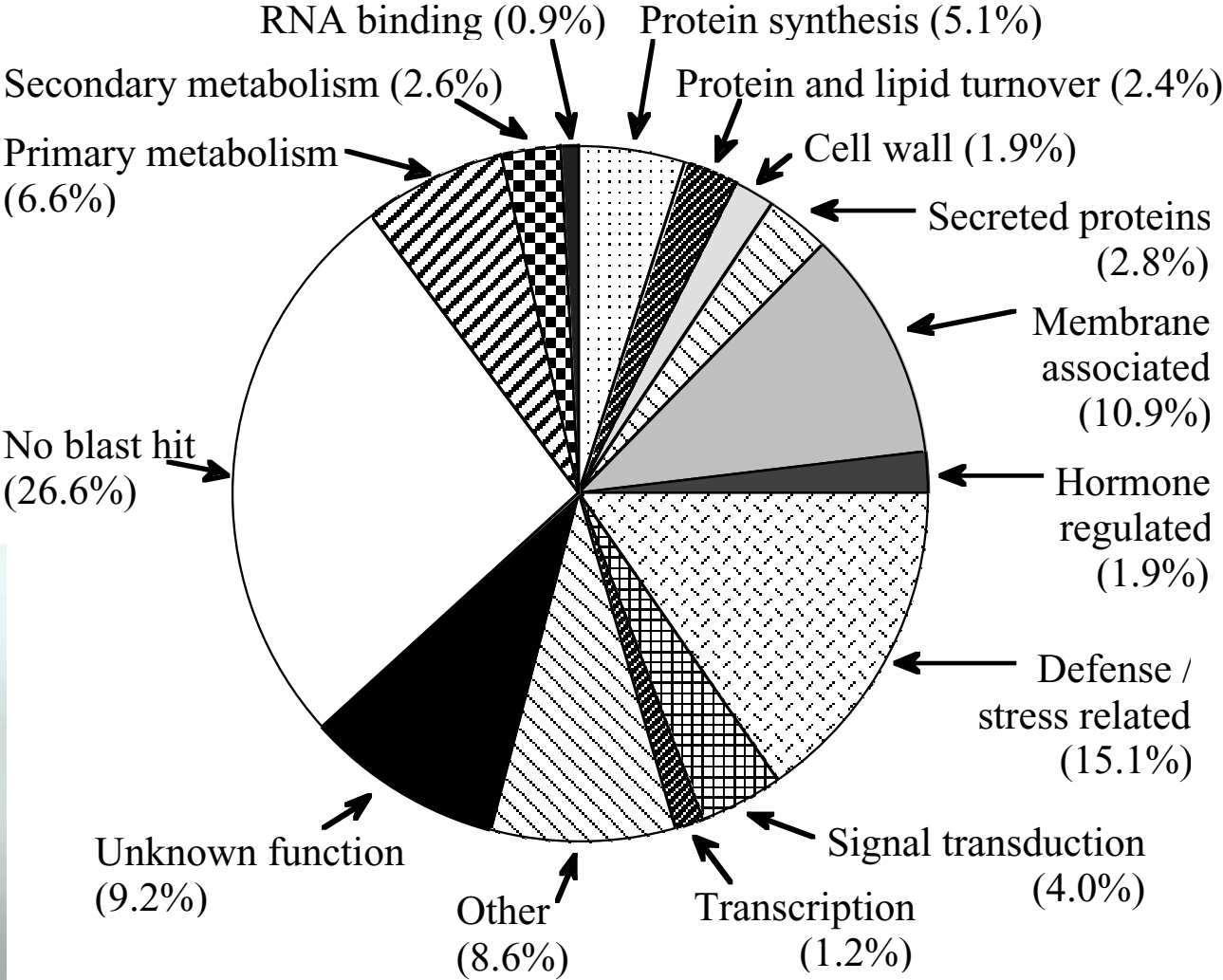
Characterization of genes and enzymes involved in scent production in roses

- 2 years ago : 20 rose sequences in gene databases**
- Genomic approach : random sequencing of genes
expressed in rose petals**

Channelière *et al.*, 2002

Guterman *et al.*, 2002

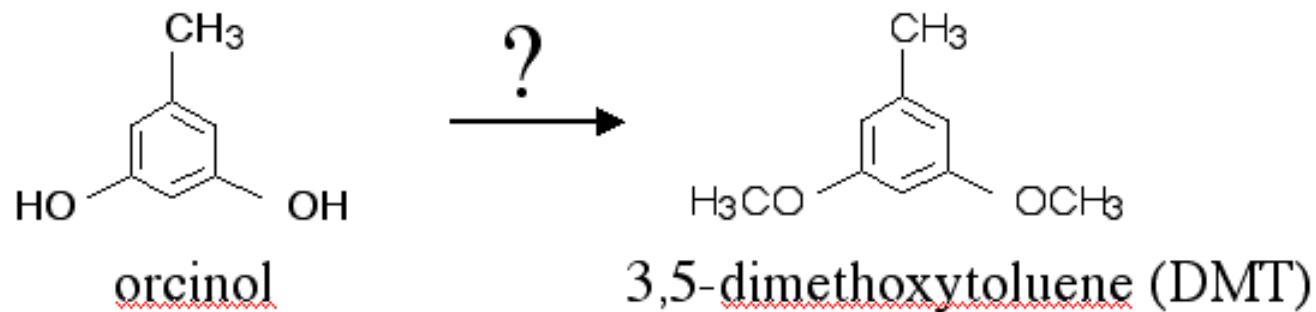
Functional classification of the rose petal ESTs



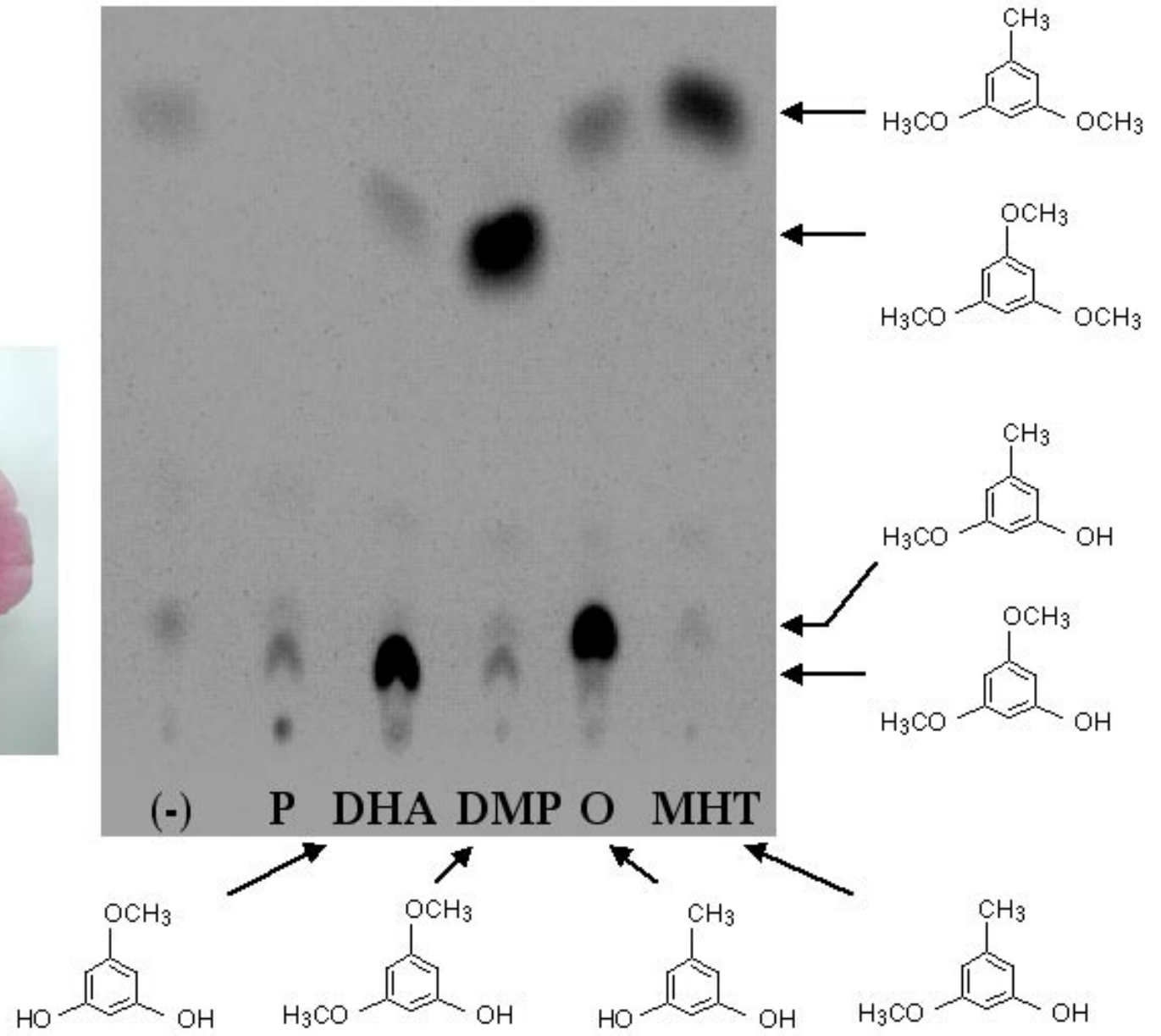
One of the major ESTs :

Homology to O-methyltransferase...

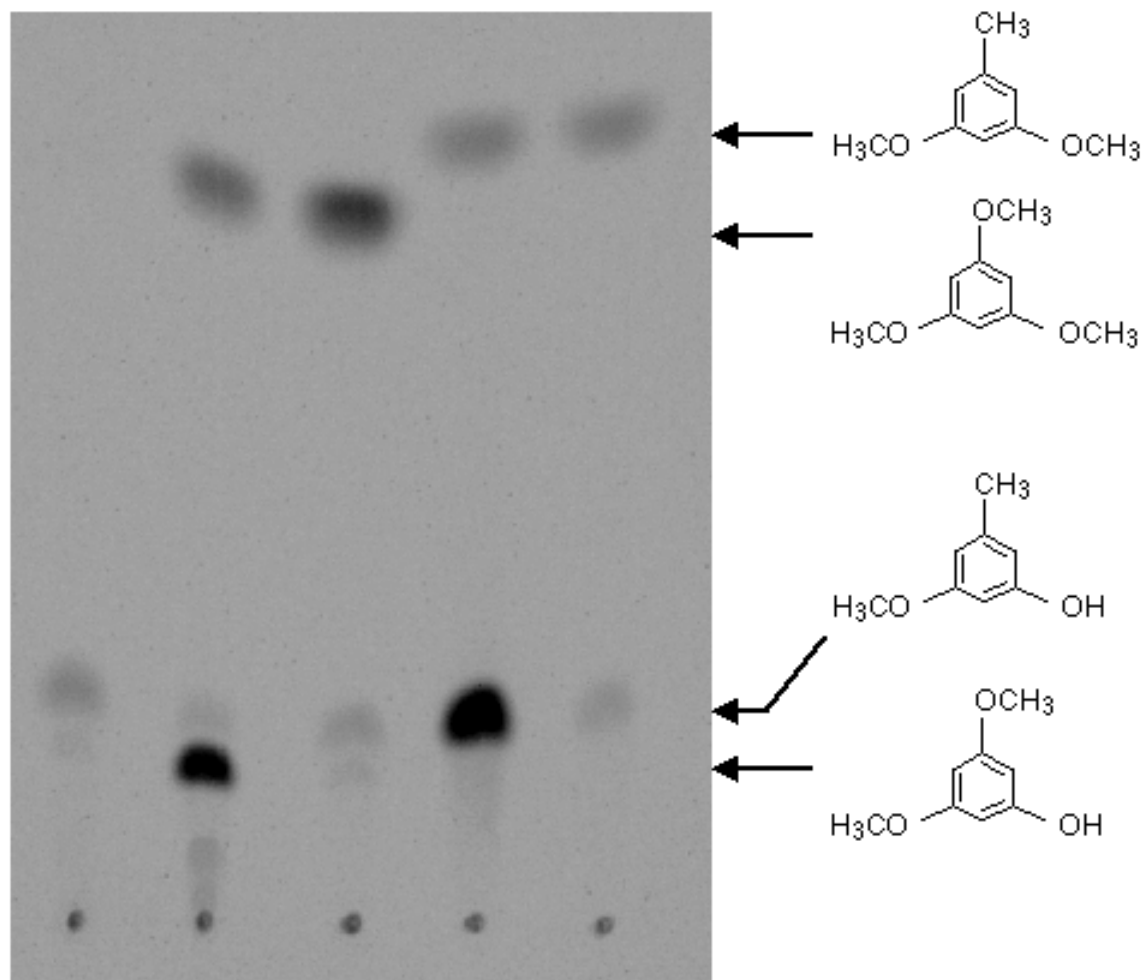
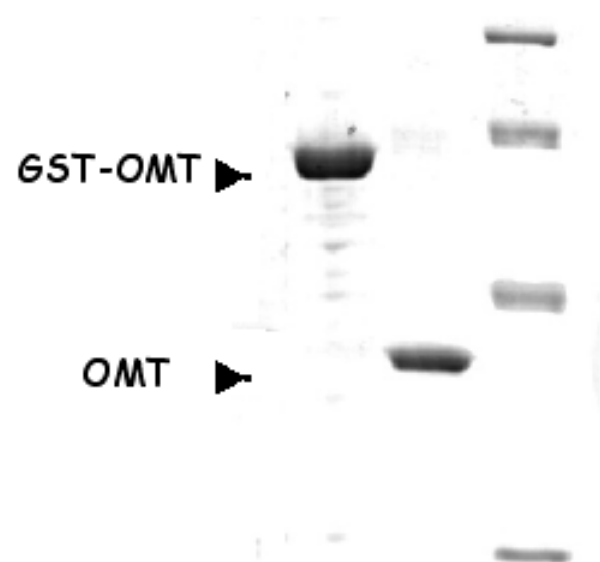
Hypothesis :



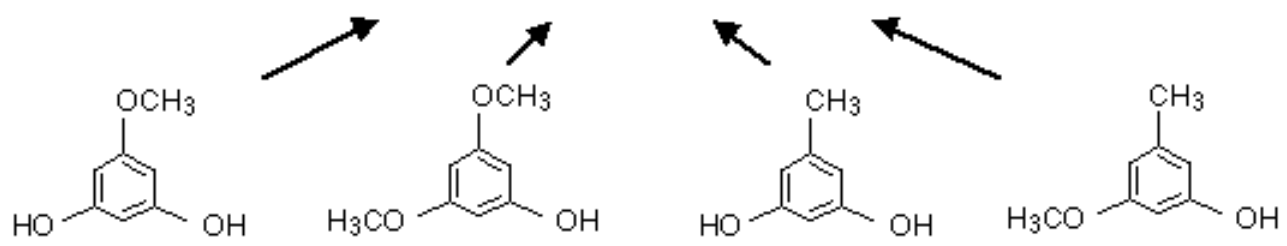
OMT activity in rose petal extracts



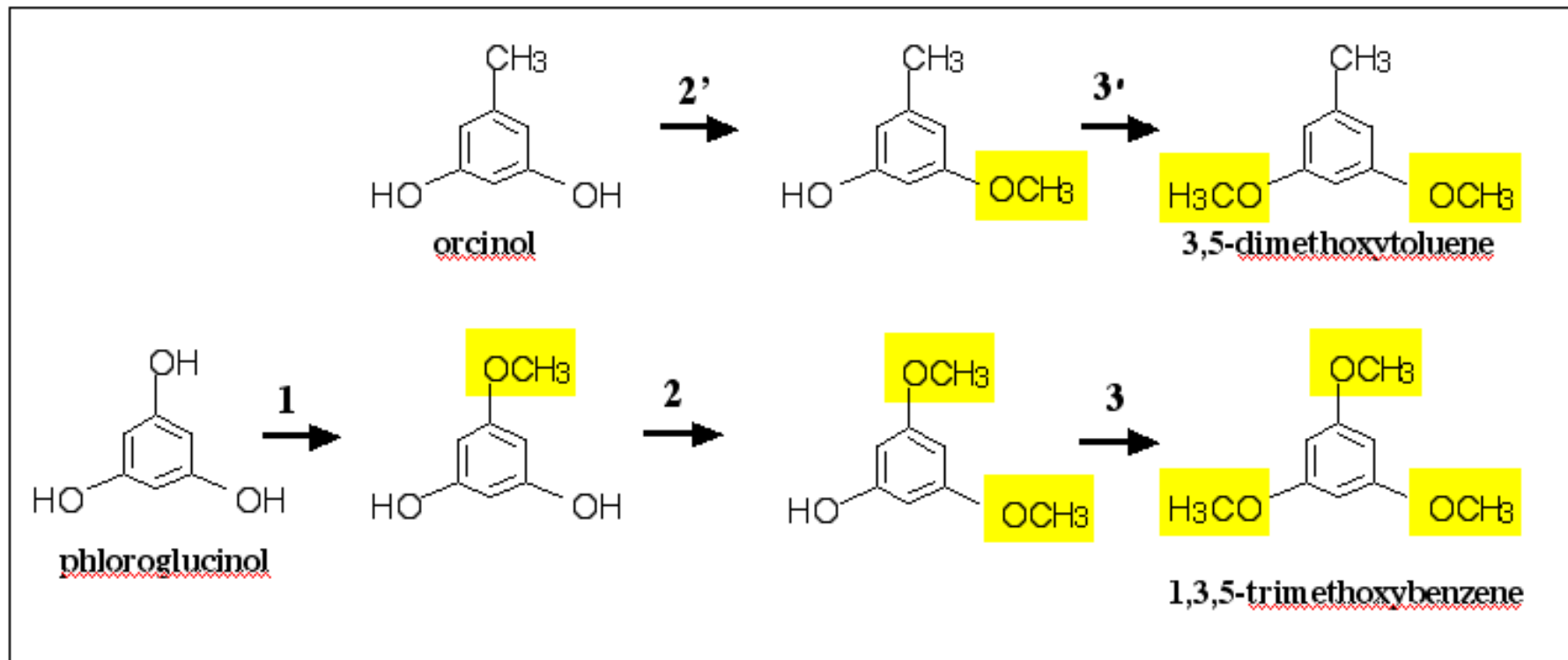
Rose O-methyltransferase expressed in *E. coli*

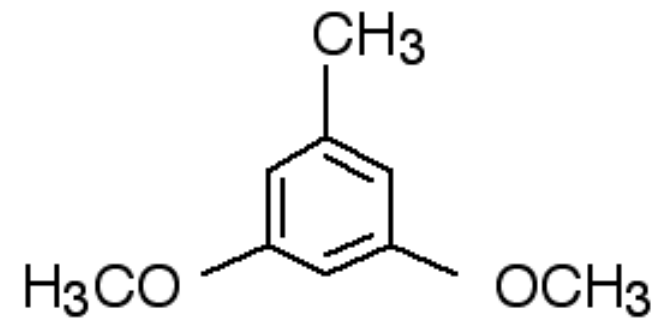


P DHA DMP O MHT



Characterization of a new type of O-methyltransferase :
orcinol-OMT (OOMT),
the first scent-specific enzyme from rose

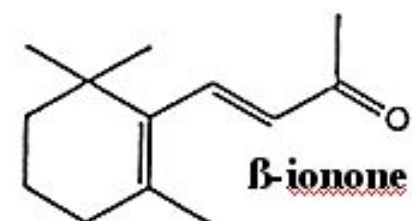
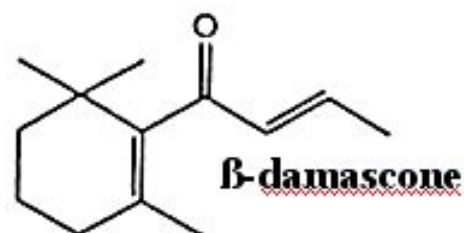
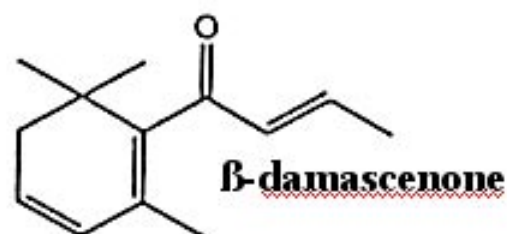




3,5-dimethoxytoluene

Major compound in Shiseido's
"Relaxing Fragrance"

A special kind of scent compounds : rose ketones

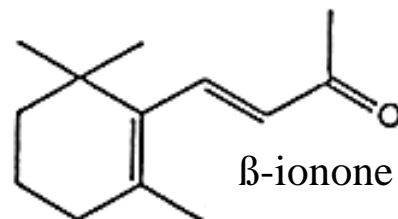


Discovery of rose ketones
---> new generations of perfumes....

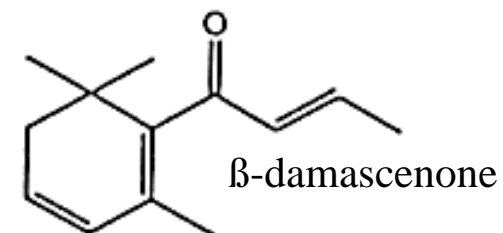
Ex : Poison (Dior, 1985)

Detection thresholds (ppb) (human)

β -ionone 0.007

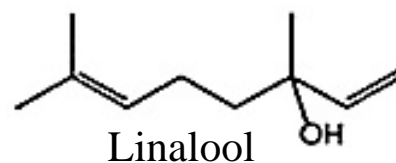


β -damascenone 0.009



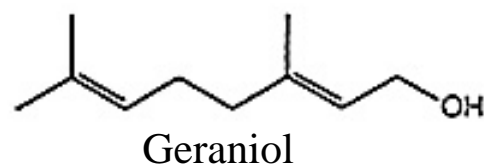
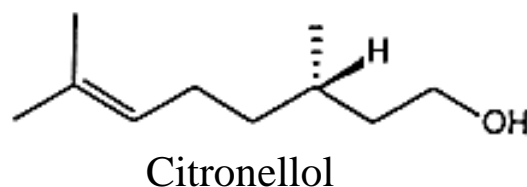
(1 μ l / 100 m³)

Linalool 6



Citronellol 40

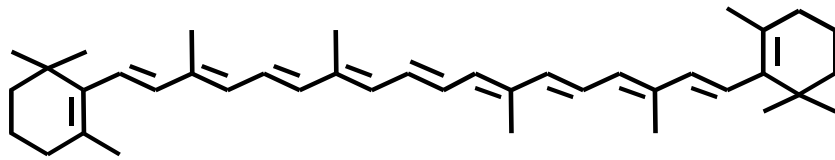
Geraniol 75



***Alister Stella Gray* (Noisette)**



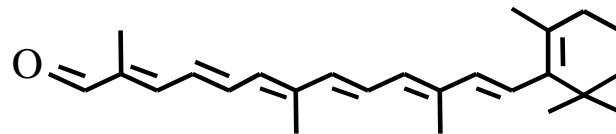
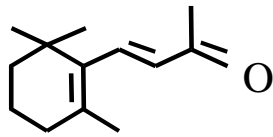
Rose ketones biosynthesis



Carotenoids

**carotenoid-
dioxygenase**

**oxidative
clivage**

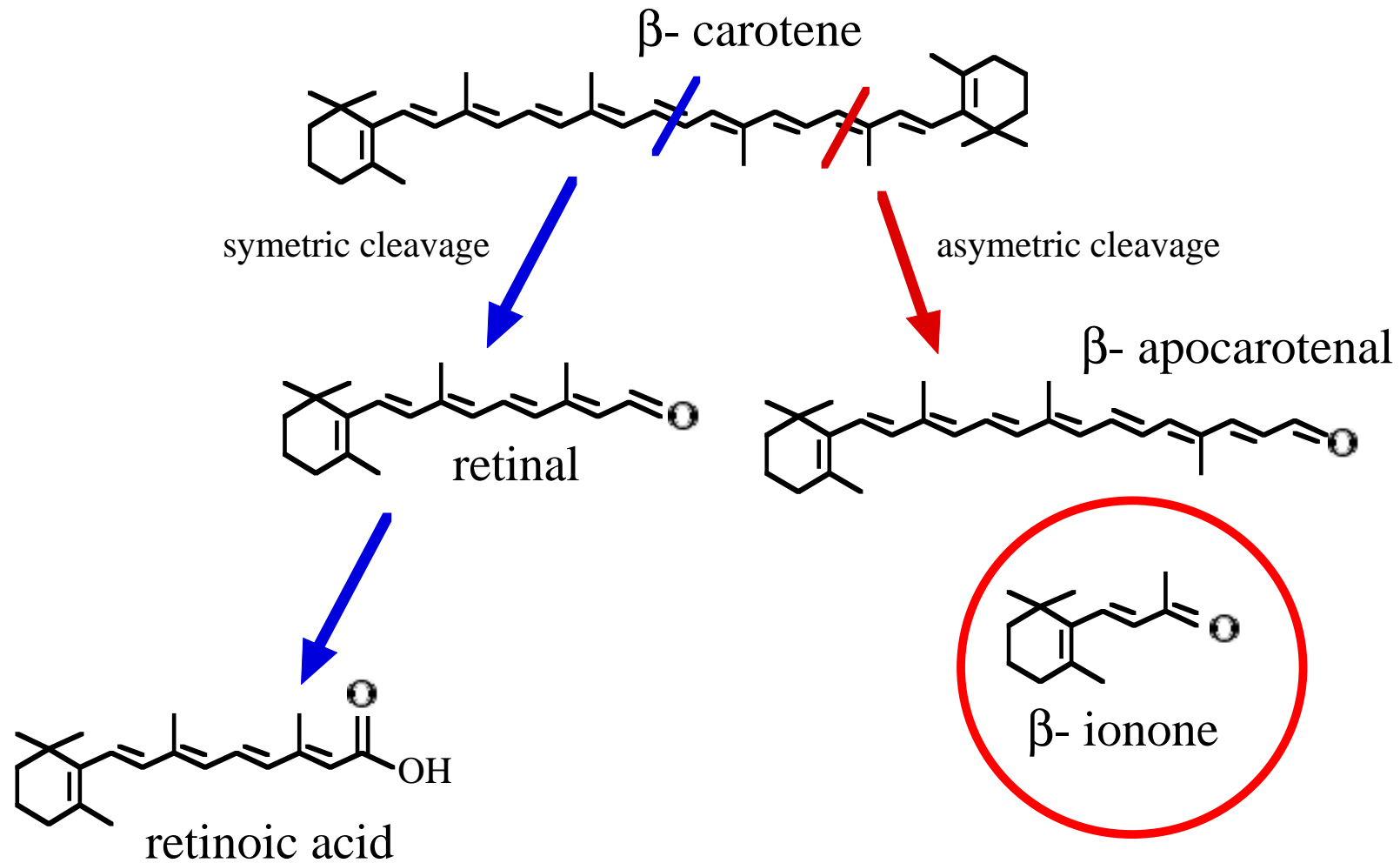


Rose ketones :

- β -ionone
- β -damascenone



Carotenoid cleavage in mammals



Plant Reproduction and Development (C.Dumas), CNRS,INRA,ENSL,UCBL

The "Rose" lab

G. Scalliet P. Hugueney M. Cock M. Bendahmane



S. Channelière

P. Vergne

C. Dolle

J. Szecsi

The "Rose" lab in St Etienne

S. Baudino
F. Jullien
J.L. Magnard
V. Bergognoux

