

ANTIMICROBIAL ACTIVITY OF PLANT ESSENTIAL OILS

B. Biavati, R. Piccaglia, M. Marotti

**Dep. of Agroenvironmental Science and Technology
University of Bologna
Italy**



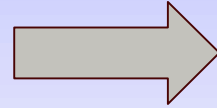
Essential oils

Secondary metabolites from vegetative and pre-flowering phases in officinal plants



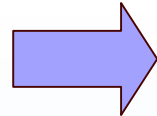
Essential oils

- **Distribution**



Present in about **50 families**
(*Lamiales, Asterales, Rutales*)

- **Localization**



Flowers

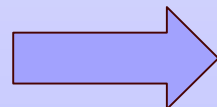


Leaves



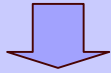
Barks, Woods, Rhizomes, Fruits, Roots, Seeds

- **Quantity**



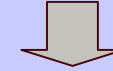
Normally lower than 1%

Plant interactions



Allelopathic agents

Plant-animal interactions



Protection against predator

Ecological role



Attraction of pollinating species



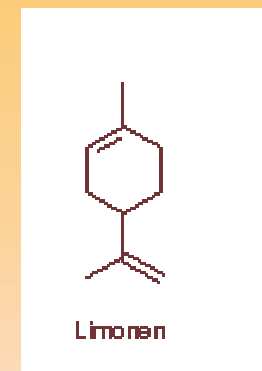
Chemical composition

Terpenes

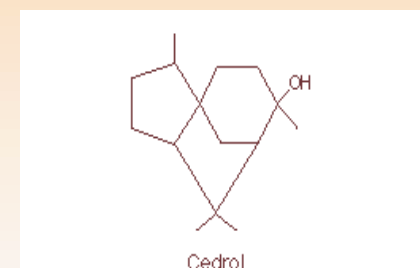
several thousands compounds with multiple functionalized molecules



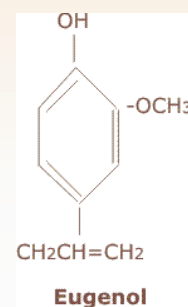
Monoterpenes



Sesquiterpenes



Aromatic compounds
derived from phenylpropane



Compounds of miscellaneous origin

Influence of cultivation practices



Influence of vegetative cycle

Influence of environmental factors



Factors influencing the variability of essential oils' composition



Occurrence of chemotypes

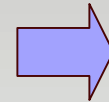
Stocking the material for extraction

Conservation of the oils

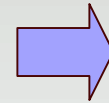
Methods of production



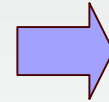
Steam distillation



Simple



Saturated

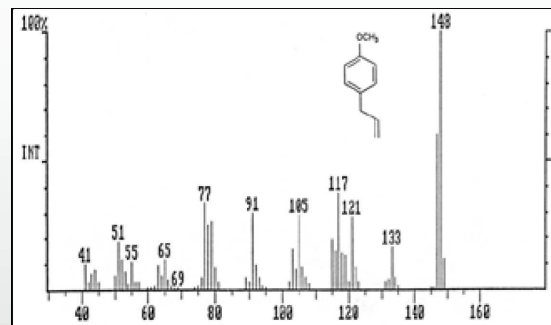


Hydrodiffusion

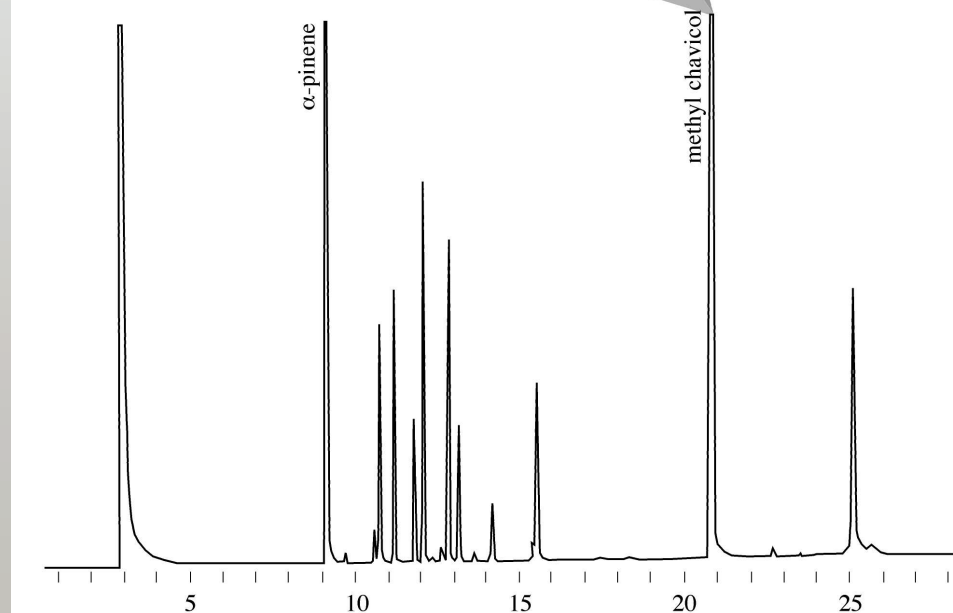
Methods of characterization

Analyses

MS



GC



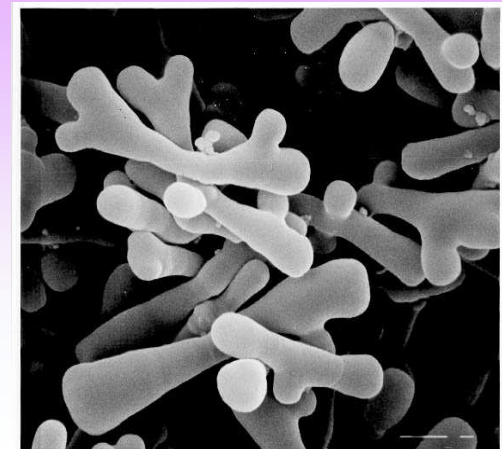
Biological activity of essential oils

- **Antimicrobial**
- **Antioxidant**





**The antimicrobial activity of 29
oils has been tested on 59
microorganisms**



The essential oils tested came from different families:

Lamiaceae
14

Asteraceae
5

Cupressaceae
2

Apiaceae
2

Lauraceae
2

Verbenaceae
1

Monimiaceae
1

Myrtaceae
1

Geraniaceae
1

Bacillus spp. (8)

Bifidobacterium spp. (8)

Clostridium spp. (9)

Streptococcus spp. (7)

Lactobacillus spp. (8)

Pectobacterium carotovorum subsp. carotovorum

Pseudomonas spp. (8)

Xanthomonas arboricola pv. pruni

Rhizobium vitis



Microorganisms tested



Schizosaccharomyces japonicus

Kluyveromyces marxianus

Schizosaccharomyces pombe

Saccharomyces cerevisiae

Zygosaccharomyces bailii

Pichia membranaefaciens

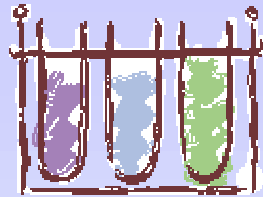
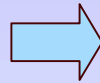
Torulasporea delbrueckii

Candida sake

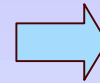
Determination of antimicrobial activity: MIC



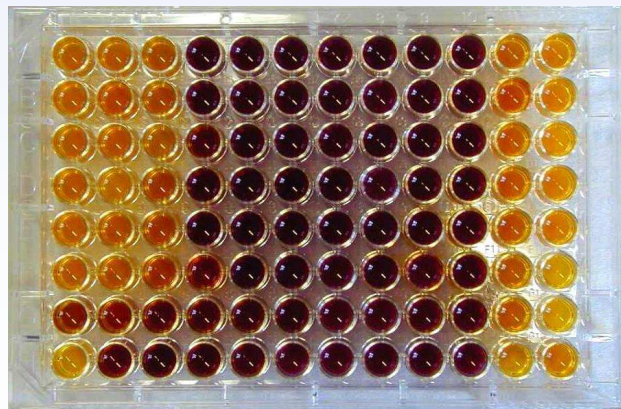
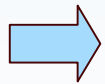
Oil/ethanol stock solution (1/10, v/v)



Serial dilution in nutritive broth



Increasing concentrations spreaded in a range of 200 to 2000 ppm



- Assessing bacterial growth
- Determining pH
- Observing bromocresol colour changes

Lamiaceae family's oils' activity

no
inhibition



Pennyroyal
Peppermint
Sage
Lavandin "Abrialis"
Lavandin "Grosso"
Lavandin "Super A"
Bergamot

75-100%
inhibition
only on



Bacteria

Basil

75-100%
inhibition
on both



Yeasts



Bacteria

Spanish oregano
Oregano
Rosemary
Thyme (*T. capitatus*, *T. vulgaris*)
Savory (*S. cuneifolia*, *S. hortensis*)

Other families' oils' activity

Asteraceae

- Mugwort
- Santolina
- Costmary
- Tansy
- Wormwood

Coupressacae

- Cypress
- Juniper

Geraniaceae

Geranium

Lauraceae

- Laurel
- Cinnamon

Myrtaceae

Clove

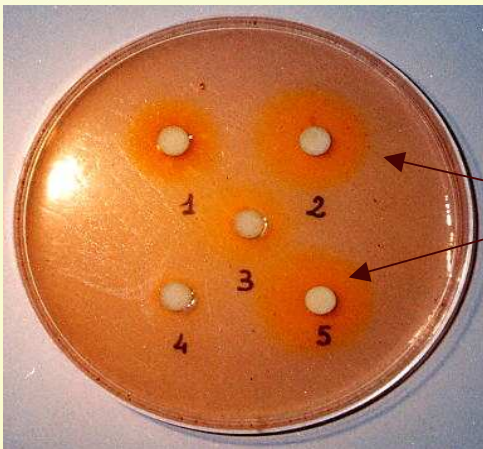
Antioxidant activity

Solution of:

Agar

2% linoic acid (2mg/ml)

10% β carotene (2mg/ml)



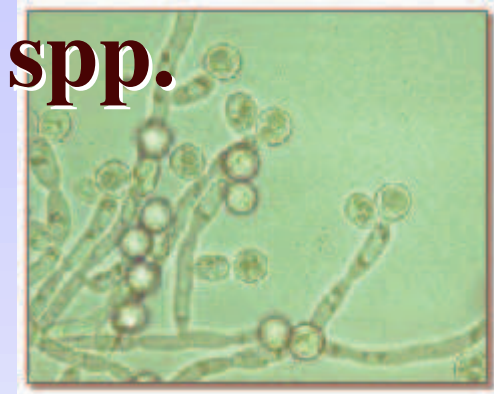
After incubation at 45°C for 4 hours:

The halo around filters is proportional to the antioxidant activity

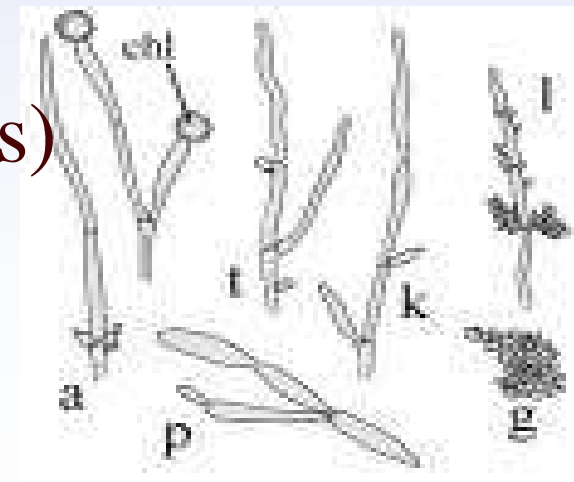
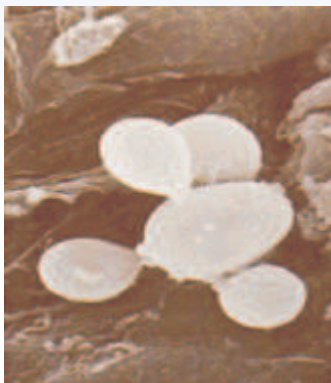
Size of the haloes in mm

Spanish oregano	26
Clove	24
Oregano	22
Cinnamon, Sage	20
Lavandin “Super a”, Thyme	18
Juniper, Bergamot	17
Peppermint, Savory	14
Geranium	13
Boldo, Basil	12
Laurel	9
Lavandin “Abrialis”, Rosemary	7

Antibiotic activity of 7 essential oils on 60 strains of *Candida* spp.



- *Candida albicans* (32 strains)
- *Candida glabrata* (3 strains)
- *Candida lypolitica* (1 strain)
- *Candida parapsilosis* (24 strains)



Results

**Lavandin, Tea tree,
Peppermint**

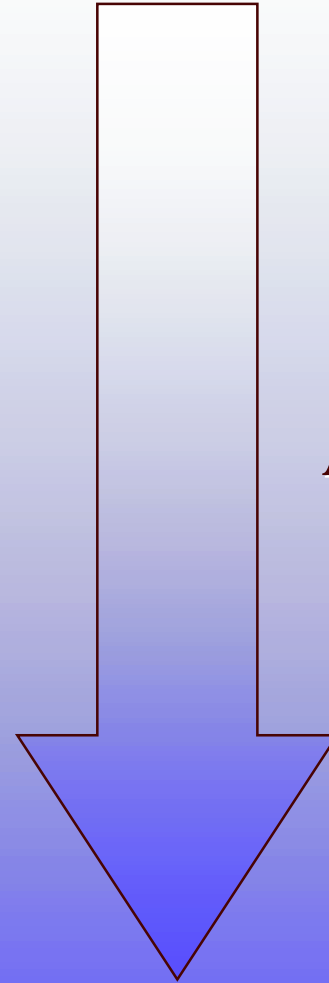
No antimicrobial activity

Juniper

**Antimicrobial activity only
on *Candida lipolytica***

Cinnamon, Oregano, Thyme

**Great antimicrobial
activity**



Essential oils' strength compared with antifungal agents'

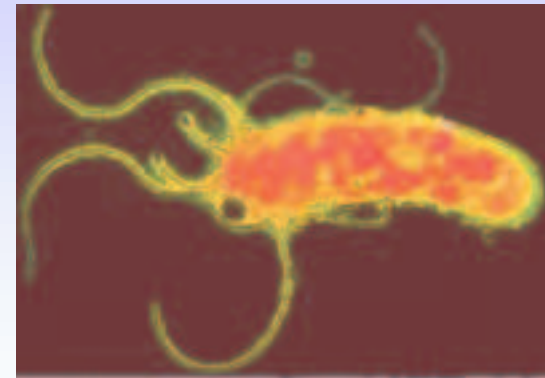
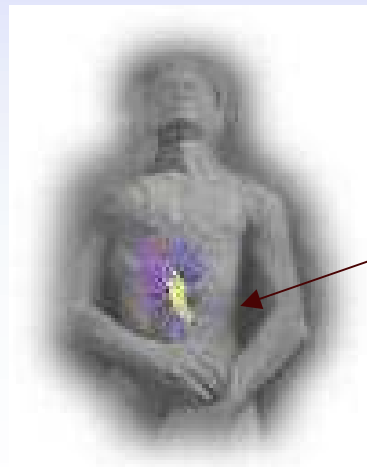
Yeasts spp.	Essential oils	Amphotericin B	Fluconazole
<i>C. albicans</i>	0.4-0.8 ^a	< 1	1
<i>C. glabrata</i>	0.4-0.8	<1	16
<i>C. lipolytica</i>	0.2-0.4	2	?
<i>C. parapsilosis</i>	0.4	<1	4

^aValues expressed in µg/ml

Antibacterial activity against *Helicobacter pylori*

H.pylori is proved to play an important role to:

- Etiology of human antral gastritis
- Peptic ulcer disease



Essential oils' inhibition activity

Among the 21 essential oils tested only 3 showed a clear bactericide effect on *Helicobacter pylori*



Onion → **200 ppm**



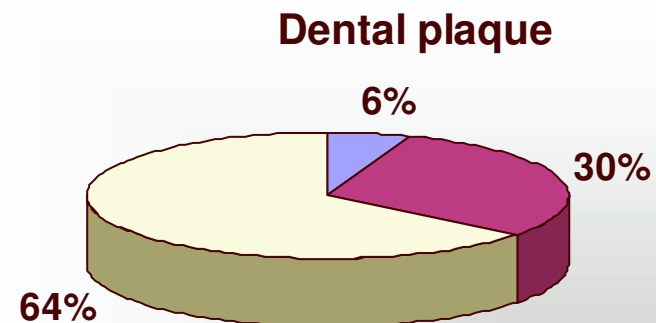
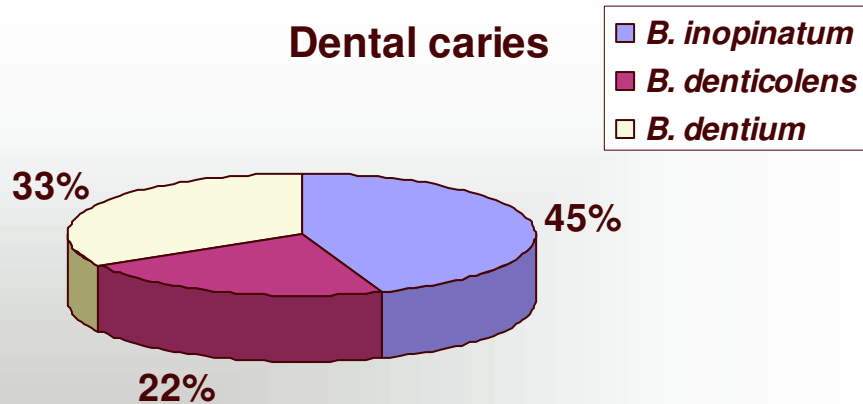
Cinnamon → **800 ppm**



Clove → **1800 ppm**

Antibacterial activity against bifidobacteria strains from oral cavity

	Dental caries	Dental plaque
Samples	19	15
Bifidobacteria	72	127



MIC ranges in dental caries and plaque isolates

	<i>B. inopinatum</i>	<i>B. dentium</i>	<i>B. denticolens</i>
Cinnamon	200 – 400 ^a	200 - 400	200 - 400
Oregano	400 - 1200	800 - 1000	400 - 600
Spanish oregano	400 - 800	600 - 800	400 - 600
Savory	400 - 1000	600 - 1000	400 - 600
Thyme	> 1000	400 - 1000	400 - 800
Basil	> 1000	> 1000	400 - 600
Clove	> 1000	> 1000	400 - 800
Geranium	> 1000	> 1000	400 - 600
Lavandin “Grosso”	> 1000	> 1000	600 -1000
Peppermint	> 1000	> 1000	600 -1000

^aValues expressed in ppm

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