Characterization and biological activity of several essential oils from different species

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Introduction

Essential oils are complex mixtures of biologically active substances used for a long time as constituents of commercial products (Morris et al., 1979). In recent years, several researches dealing with the properties of essential oils evidenced their antibacterial, antioxidant and antifungal activities (Piccaglia et al., 1993; Shapiro et al., 1994). The availability of these substances is of great economical importance considering the increasing demand of natural ingredients in food, cosmetic and pharmaceutical industries. **In this work**, twenty four essential oils, obtained from the same number of species belonging to eight botanical families and isolated by steam distillation, were considered.

Materials and methods

Aromatic plants
Species belonging to *Apiaceae, Asteraceae, Cupressaceae, Geraniaceae, Lamiaceae, Lauraceae, Myrtaceae* and *Verbenaceae* families.

Essential oils
Several of them obtained by steam distillation of fresh material in our laboratory; the other ones purchased from commercial suppliers.

Microorganisms
Bacteria (30) belonging to *Agrobacterium, Bacillus, Bifidobacterium, Clostridium, Erwinia, Lactobacillus, Pseudomonas, Streptococcus* and *Xanthomonas* genera and yeasts (68) belonging to *Candida, Kluyveromyces, Pichia, Saccharomyces, Schizosaccaromyces, Torulaspora* and *Zygosaccaromyces* genera.

Oil analysis: GC/MS.

Antimicrobial activity:
MIC (Minimun Inhibitory Concentration) was determined by broth dilution method and was tested in the range 200-2000 ppm. Inoculated plates were incubated for 48h. The lowest concentration in which no growth occurred was taken as the MIC.

Antioxidant activity: filters (6 mm) soaked with a drop of tested oil were put on agar added with linoleic acid and β–carotene and incubated at 45°C for about 4 h.The zone of colour retention around each filter showed the region of antioxidant activity (**Fig. 1**).

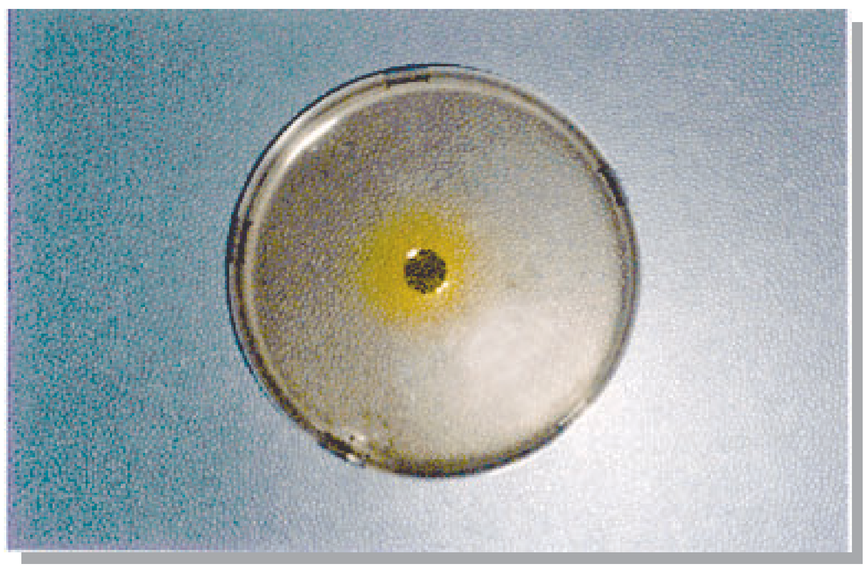


Fig. 1. Antioxidant activity.

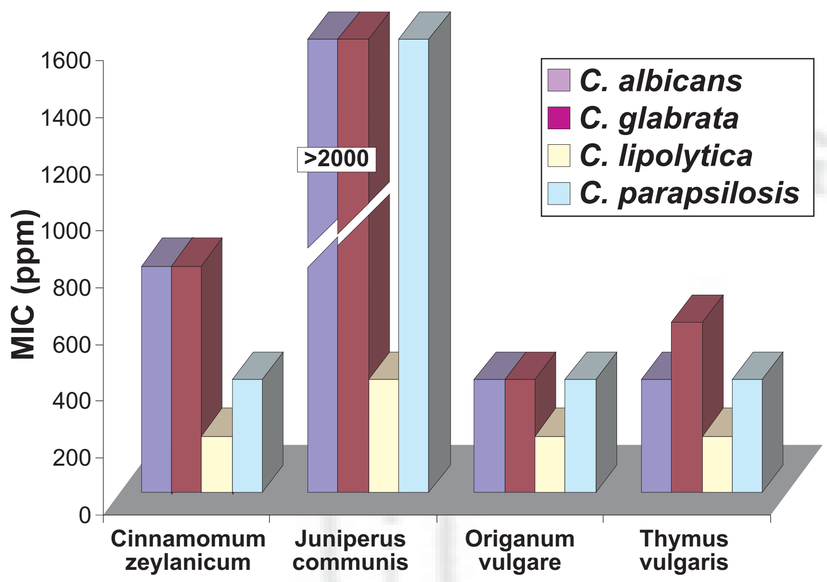
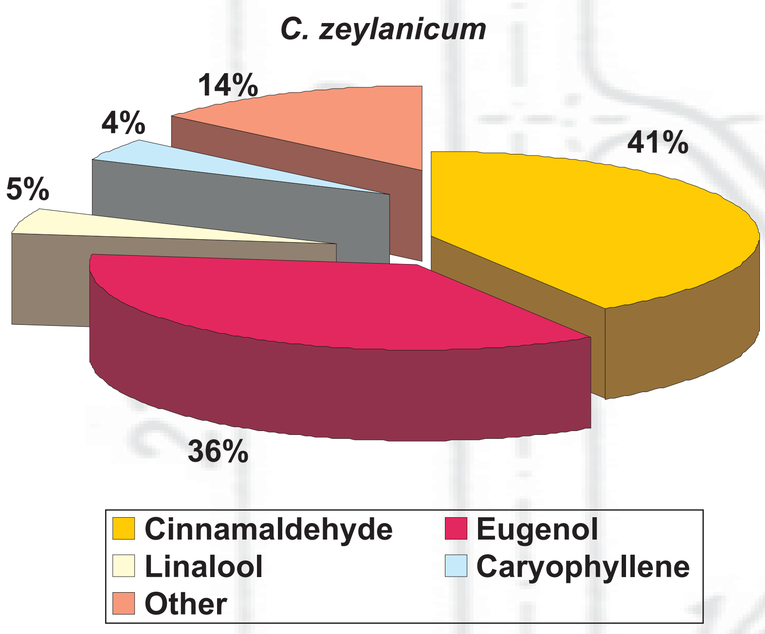


Fig. 2. MIC of essential oils towards some *Candida* species.



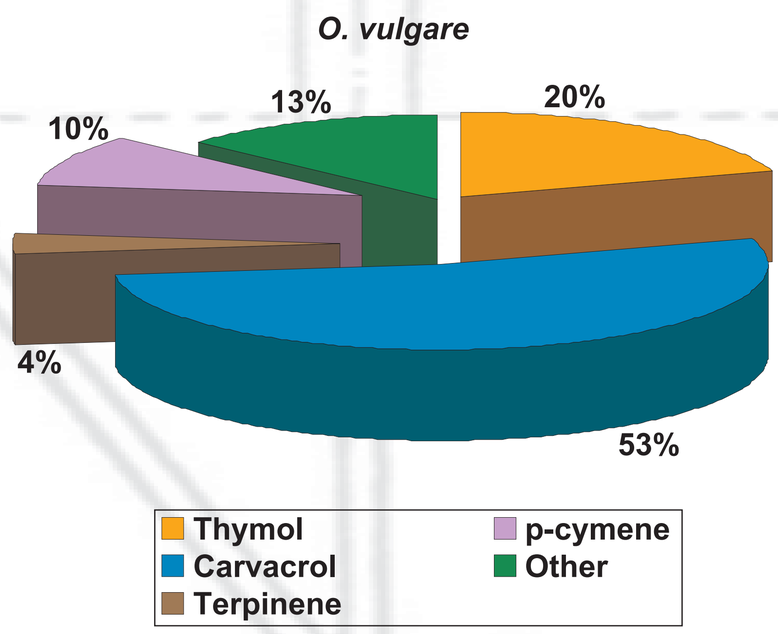


Fig. 3. Composition of two essential oils.

Conclusions

***C. zeylanicum* and *E. caryophyllata*, tropical crops, *T. capitatus*, *T. vulgaris* and *O. vulgare*, typical plants of the Mediterranean area, highlighted excellent biological properties.**

These properties, suitably exploited, could find application in food, beverage, pharmaceutical and agricultural industries making these plants susceptible of increasing attention.

References

Morris, J. A., Khettry, A., and Seitz, W., 1979. Journal of the American Oil Chemists' Society, 56, 595-603.
Piccaglia, R., Marotti, M;, Giovanelli, E. Deans S. G. and Eaglesham, E., 1993. Industrial Crops and Products, 2, 47-50.
Shapiro, S., Meier, A. and Guggenheim, B., 1994. Oral Microbiol. Immunol., 9, 202-208.

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Results and discussion

Most of the essential oils exhibited a good antimicrobial activity. In particular, those from *T. capitatus*, *C. zeylanicum* and *E. caryophyllata* showed a complete inhibition of the bacterial growth (**Tab. 1**) and those from *C. zeylanicum, T. vulgaris, O. vulgare* and *J. communis* were very effective against yeasts at low MIC values ranging from 200 to 400 ppm (**Tab. 2**). These last oils were tested also for the control of several *Candida* strains of medical interest (**Fig. 2**) and they showed good results with MIC ranging from 200 to 800 with the exception of *J. communis* oil which was not effective against two strains.

Moreover, oils with high antimicrobial activities showed good antioxidant properties and, in particular, that from *E. caryophyllata* resulted with a larger retention color zone (24 mm) than the other ones (**Tab. 3**).

The characterization of essential oils evidenced in those having high biological activity, relevant amounts of aromatic phenols and aldheydes such as thymol and carvacrol typical compounds of *O. vulgare, T. capitatus* and *T. vulgare* oils whereas eugenol and cinnamaldheyde were the main constituents of *E. caryophyllata* and *C. zeylanicum* (**Fig. 3**).

Tab. 1. Essential oils with high antimicrobial activity.

Essential oil	Inhibited strains (%)
Cinnamomum zeylanicum	100
Eugenia caryophyllata	100
Thymus capitatus	100
Origanum vulgare	97
Thymus vulgaris	93
Balsamita major	92
Pelargonium odoratissimum	90
Thymbra sintenesii	89
Satureja montana	95
Monarda didyma	82
Rosmarinus officinalis	78
Laurus nobilis	58
Mentha pulegium	53

Tab. 2. MIC of essential oils inhibiting the growth of all the tested yeasts.

Essential oils	C.s	K.m	P.m	S.c	Sc.j	Sc.p	T.d	Z.b
Balsamita major	400	800	800	800	400	800	800	600
Cinnamomum zeylanicum	200	200	200	200	200	200	200	200
Eugenia caryophyllata	600	800	400	400	600	400	400	400
Juniperus communis	400	200	200	200	200	200	200	200
Lavandula hybrida	1600	1800	1400	1200	1400	1400	1400	1200
Mentha x piperita	400	1000	400	400	800	600	400	400
Ocimum basilicum	1200	1400	800	800	1600	800	1400	1000
Origanum vulgare	200	400	200	200	200	200	200	200
Pelargonium odoratissimum	800	1000	400	600	600	600	600	400
Satureja montana	400	400	200	200	200	200	200	200
Thymbra sintenesi	800	1200	600	600	800	600	600	600
Thymus capitatus	600	600	400	600	200	200	200	600
Thymus vulgaris	400	400	200	200	200	200	200	200

C.s = *Candida sake*; **K.m** = *Kluyveromyces marxianus*; **P.m** = *Pichia membranaefaci*; **S.c** = *Saccharomyces cerevisiae*; **Sc.j** = *Schizosaccaromyces japonicus*; **Sc.p** = *Schizosaccaromyces pombe*; **T.d** = *Torulaspora derbrueckii*; **Z.b** = *Zygosaccaromyces bailii*.

Tab. 3. Essential oils showing higher antioxidant activities.

Essential oil	Zone of retention color (mm)
Eugenia caryophyllata	24
Origanum vulgare	22
Thymus vulgaris	22
Cinnamomum zeylanicum	20
Ocimum basilicum	18
Satureja montana	18
Lavandula hybrida	18
Monarda didyma	17
Juniperus communis	17
Mentha x piperita	14
Thymus capitatus	14
Pelargonium odoratissimum	13
Thymbra sintenesii	13