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Short report

Essential oils of commonly used plants as inhibitors of peroxynitrite-induced tyrosine nitration

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Abstract

The essential oils obtained from fifteen relevant and commonly used plants belonging to Cruciferae, Lamiaceae, Lauraceae, Apiaceae, and Zingiberaceae were screened using an in vitro model of peroxynitrite-induced tyrosine nitration. Almost complete inhibition of 3-nitrotyrosine formation (91% at 300 μg/ml) was achieved only with the essential oil obtained from the leaves of *Laurus nobilis*. 1,8-Cineol, accounting for a 50% of this essential oil, which resulted as inactive in this model, thus evidencing a major role for the minor volatile compounds present in the leaves.

Keywords: *Laurus nobilis*; Peroxynitrite; 3-Nitrotyrosine; Essential oil; 1,8-Cineol

1. Plant

Botanical name, family, and investigated part of the plants are reported in Table 1. All the plant material was purchased from the local market except *Sinapis* alba, *Zingiber*

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Table 1
In vitro inhibition of 3-nitrotyrosine formation by selected plants' essential oils

Plants	Common name	Part used	%I^a
Cruciferae			
Sinapis alba	Mustard	Fruits	0
Lamiaceae			
Lavandula spica × latifoglia	Spike lavender	Flowers	0
Lavandula officinalis	Lavender	Flowers	0
Origanum majorana	Oregano	Aerial parts	8
Rosmarinus officinalis	Rosemary	Aerial parts	21
Salvia officinalis	Sage	Aerial parts	0
Thymus vulgaris	Thyme	Aerial parts	36
Mentha spicata	Mint	Aerial parts	38
Lauraceae			
Laurus nobilis	Bay	Leaves	91
Apiaceae			
Carumi carvi	Caraway	Fruits	0
Coriandrum sativum	Coriander	Fruits	45
Foeniculum vulgare	Sweet fennel	Fruits	39
Pimpinella anisum	Anise	Fruits	0
Zingiberaceae			
Zingiber officinalis	Ginger	Roots	0
Curcuma zedoaria	Zedoary	Roots	0
1,8-Cineol (500 μM)	–	–	0
Ascorbic acid (405 μM)	–	–	50

[a] Percentage of in vitro inhibition of 3-nitrotyrosine formation (essential oils were assayed at a final concentration of 300 μg/ml).

officinalis, *Curcuma zedoaria*, *Carumi* carvi, and *Coriandrum* sativum that were obtained from RES Pharma s.r.l. (Milano, Italy).

2. Uses in traditional medicine

Antimicrobial, antifungal, digestives, mouthwashes, wound healing, and balsamic actions [1].

3. Previously isolated classes of constituents

Terpenoids [1].

4. Tested material

Essential oils were obtained by hydrodistillation in a Clevenger apparatus for 2 h as described in the Italian Pharmacopea XI ed. 1,8-Cineol and ascorbic acid were purchased from Sigma-Aldrich.

5. Studied activity

Inhibition of in vitro peroxynitrite-induced tyrosine nitration. Briefly, the reaction was carried out adding, under vigorous vortexing, the peroxynitrite synthesised according Beckman et al. [2] (1 mM final concentration) to a solution containing the essential oil or pure compounds at the desired concentrations, tyrosine (2 mM) and HCO_3^- (50 mM) all dissolved in 50 mM phosphate buffer (pH 7.4). Test compounds were dissolved in MeOH (final concentration of 0.5%) and kept into ice till used. Controls, with or without MeOH, were always performed to detect any interference of the solvent with the tests. Quantitative determination of the formed 3-nitrotyrosine was performed by HPLC–UV using an external standard calibration curve ($r^2 = 0.999$). Ascorbic acid was used as a positive reference compound.

6. Results

The composition of the essential oil obtained from leaves of *L. nobilis* was determined by GC–MS and resulted to be: 1,8 cineol (50%), sabinene (9%), linalool and α-terpinyl-acetate (6% each), α-pinene (5%), β-pinene and methyleugenol (4% each), and other identified minor compounds (2–0.5%) accounting for 98.84% of the total oil composition. Complete results are reported in Table 1.

7. Conclusions

This is the first report on the activity of essentials oils as inhibitors of peroxynitrite mediated processes. Nitration of tyrosine residues in key proteins is a process mediating many acute and chronic pathologies [3] and 3-nitrotyrosine is considered a biomarker of the oxidative stress [4]. In this screening, the essential oil obtained from leaves of *L. nobilis* provided the highest in vitro protection against tyrosine nitration. Its main component, 1,8-cineol, resulted inactive, evidencing that minor compounds and/or complex interactions between the components of the essential oil play an important role.

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