Tutti parlano di oli essenziali ma......!
Qualche considerazione generale sulla loro natura
Parte 1

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Why essential oils are in the eye of the storm?

..... according to the economic outlook for 2022-2032 of the think tank of a big-pharma:

...... the market of essential oils is set to grow from USD 4.5 billion in 2022 to USD 12-13 billion in 2032!

Indicative costs of some popular essential oils:
- Peppermint EO: 25-95 USD/Kg
- Lavender EO: 40-120 USD/Kg
- Tea tree oil: 30-70 USD/Kg

..... essential oil and quality
What has changed in the natural product research in the last three decades?

...... an ever increasing integration between chemistry and biology
Some preliminary considerations …..

… a plant is a highly effective chemical & biological laboratory producing (biosynthesizing) an unbelievable number of molecules with different structures and biological activity.

PhD thesis, tutor Prof. Tina De Tommasi – University of Salerno (Italy)

March 2023

April 2023

Chaenomeles speciosa (Sweet) Nakai - Rosaceae
some preliminary considerations

...each specialized metabolite plays a well defined role in the plant living cycle ... 

... all specialized metabolites are biologically strictly related independently on their structure 

... and all together concur to the plant metabolism.....

... a plant provides us all information we need ......

... as long as we know how to “read” it
the world of essential oils

Some definitions to clear this field of the too many misunderstandings on which (often) this world relies
A possible definition of the volatile fraction of a plant….

In biological terms, the volatile fraction emitted from a plant is an important biosensor diagnostic of the changes that take place in its metabolism.

In chemical terms, the volatile fraction of a plant is a mixture of compounds that can be recovered as a consequence of their capability to be vaporised both spontaneously and through suitable sampling conditions or techniques.

The term volatile fraction is therefore a framework including a group of approaches and/or techniques that produce samples representative of the volatiles that characterize a plant, although they may have different and mutually non-comparable compositions, e.g. headspace, essential oils, extracts obtained by specific techniques, fragrances, aromas and flavours.

Vocatilome and volatilomics*

**Plant volatilome** is defined as the complex blend of **essential oils (EOs)** and volatile organic compounds (VOCs) fed by different biosynthetic pathways and produced by plants, constitutively and/or after induction, as a defense strategy against biotic and abiotic stress.

VOCs are released from leaves, flowers and fruits into the atmosphere and from roots into the soil, while EOs are produced by specialized secretory tissues (*ndr: and obtained by dedicated technologies*). VOCs also attract pollinators, seed dispersers, and other beneficial animals and microorganisms, and serve as signals in plant–plant communication. The plant volatilome is also involved in signaling between symbiotic organisms.

The plant volatilome has wide agricultural and industrial applications ranging from the search for sustainable methods for pest control to the economically important production of flavors, fragrances and phytochemicals.

WHAT IS AN ESSENTIAL OIL

.... according to ISO 9235:2013 and European Pharmacopoeia and USP

2.11. essential oil: product obtained from a natural raw material of plant origin, by steam distillation, by mechanical processes from the epicarp of citrus fruits, or by dry distillation, after separation of the aqueous phase (if any) by physical processes

2.12. essential oil obtained by steam distillation: essential oils (2.11) obtained by steam distillation with addition of water to the still (hydrodistillation) or without addition of water to the still (directly by steam)

2.9. dry distilled essential oil: distillation of wood, barks, roots or gums, without adding water or steam

...... essential oils are therefore distillates and not extracts.......
Essential oils and sensory (analysis)

Fragrances

A fragrance can be defined as a sweet, pleasant scent perceived orthonasally from a non-food material.

...... therefore......

...... an essential oil per se is not a fragrance.

...... but it can become a fragrance (or a component of it) when sensory evaluated

* from: Belitz, H. D; Grosch, W.; Schieberle, P. Food Chemistry, 4th revised and extended ed.; Springer-Verlag: Berlin Heidelberg, 2009; Chapter 5, p 340-400.
Flavour is a general term involved with the overall sensation provided by the interaction of taste, odour and textural feeling when a food is consumed*.

International Standards Organization (ISO-5492 1992) defined flavour as a “complex combination of the olfactory, gustatory and trigeminal sensations perceived during tasting. The flavor may be influenced by tactile, thermal, painful and/or kinaesthetic effects”.

Aroma substances are volatiles that can be perceived orthonasally and retronasally by the odor receptor sites of the smell organ, i.e. the olfactory tissue of the nasal cavity.

* from: Belitz, H. D; Grosch, W.; Schieberle, P. Food Chemistry, 4th revised and extended ed.; Springer-Verlag: Berlin Heidelberg, 2009; Chapter 5, p 340-400.
…. the basic distinction between aroma and fragrance

The olfactory sense

Olfactory mucosa ~10 cm²

Orthonasal pathway (direct)

Retronasal pathway (indirect)

Fragrance

Aroma
Aromatherapy bases on the use of aromatic materials (mainly essential oils) and other aroma compounds to improve psychological and physical well-being.

It is a complementary therapy or a form of alternative medicine.

Not definitive medical evidence is given that aromatherapy can either prevent, treat or cure any disease.

Blends of supposed therapeutic essential oils can be used as topical application, massage, inhalation or water immersion.

The use of volatile products (essential oils) for therapeutic, spiritual, hygienic and ritualistic purposes goes back to ancient civilizations such as Indian, Chinese, Egyptian, Greek, Persian, Arab and Roman.

Modern aromatherapy was introduced in medicine by René-Maurice Gatufossé in 1937 with the book “Aromathérapie: Les Huiles essentielles, hormones végétales”.

René-Maurice Gatufossé
an extract is ........

.....the product of *maceration with solvents* of different characteristics, with different technologies and under different conditions of a plant or some parts of it.

therefore: ..... an extract is not a distillate
Why should essential oil field be considered as a self-consistent multitask sub-discipline?
The multiplicity of disciplines involved with essential oils

- the plant ……
- the product ……
- their composition ……
- their use ……

- Analysis
- Composition
- Isolation
- Structure elucidation
- Synthesis (sensu lato)
- Sensory evaluation
- Consistency
- Biosynthesis

- Biological activity
- Pharmacognosy
- Aromatherapy
- Pharmaceuticals
- Cosmetics
- Food
- Regulatory

- (Bio) -Technology
Essential oils and quality
Why does quality matter so much?

The concept of quality was introduced by Aristotle in the Categories.

The philosophical definition of quality is still controversial, but it has been generally seen as an attribute or a property characteristic of an object*

Essential oils and quality

Lavender essential oils and “invisible” adulterants
Quality control: adulteration of essential oils with “invisible” adulterants

Lavender EO adulteration with “fatty oils”

Economic considerations

- Lavender EO: **100-120 $/kg**
- Deodorized fatty oil: **1-4 $/kg**
- Average difference of cost for a 30% fatty oil adulteration: **30-40 $/kg**
- Entity of the lot: **100 kg**
- Difference: **3000 $**
Quality control: adulteration of essential oils with “invisible” adulterants

**Lavender EO adulteration with “fatty oils”**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Linalool</th>
<th>Linalyl acetate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area %</td>
<td>Average area</td>
</tr>
<tr>
<td>EO-St.</td>
<td>31.9</td>
<td>10346490899</td>
</tr>
<tr>
<td>EO-Unk.</td>
<td>32.3</td>
<td>6710236137</td>
</tr>
</tbody>
</table>

**GC-FID-MS of the Reference and Unknown Lavender essential oil**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Average area</th>
<th>Linalool Am. (mg/mL)</th>
<th>Area %</th>
<th>Average area</th>
<th>Linalyl acetate Am. (mg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EO</td>
<td>31.9</td>
<td>10346490899</td>
<td>36.3</td>
<td>11790276760</td>
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<tr>
<td>EO + 5% Fat</td>
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<tr>
<td>EO + 10% Fat</td>
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<tr>
<td>EO + 20% Fat</td>
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<td>8754987176</td>
<td>37.2</td>
<td>10062940335</td>
<td>16.6</td>
</tr>
<tr>
<td>EO + 30% Fat</td>
<td>32.3</td>
<td>6710236137</td>
<td>36.8</td>
<td>7574204348</td>
<td>12.5</td>
</tr>
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PPTX:

CORSO DI LAUREA IN TECNICHE ERBORISTICHE

Ciclo di incontri:
L’intelligenza delle piante
e la multidisciplinarità delle scienze erboristiche
Tavola Rotonda 2023
Cambiamento climatico, Piante selvatiche, Olii essenziali
Savigliano, 22 Maggio 2023

Grazie
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