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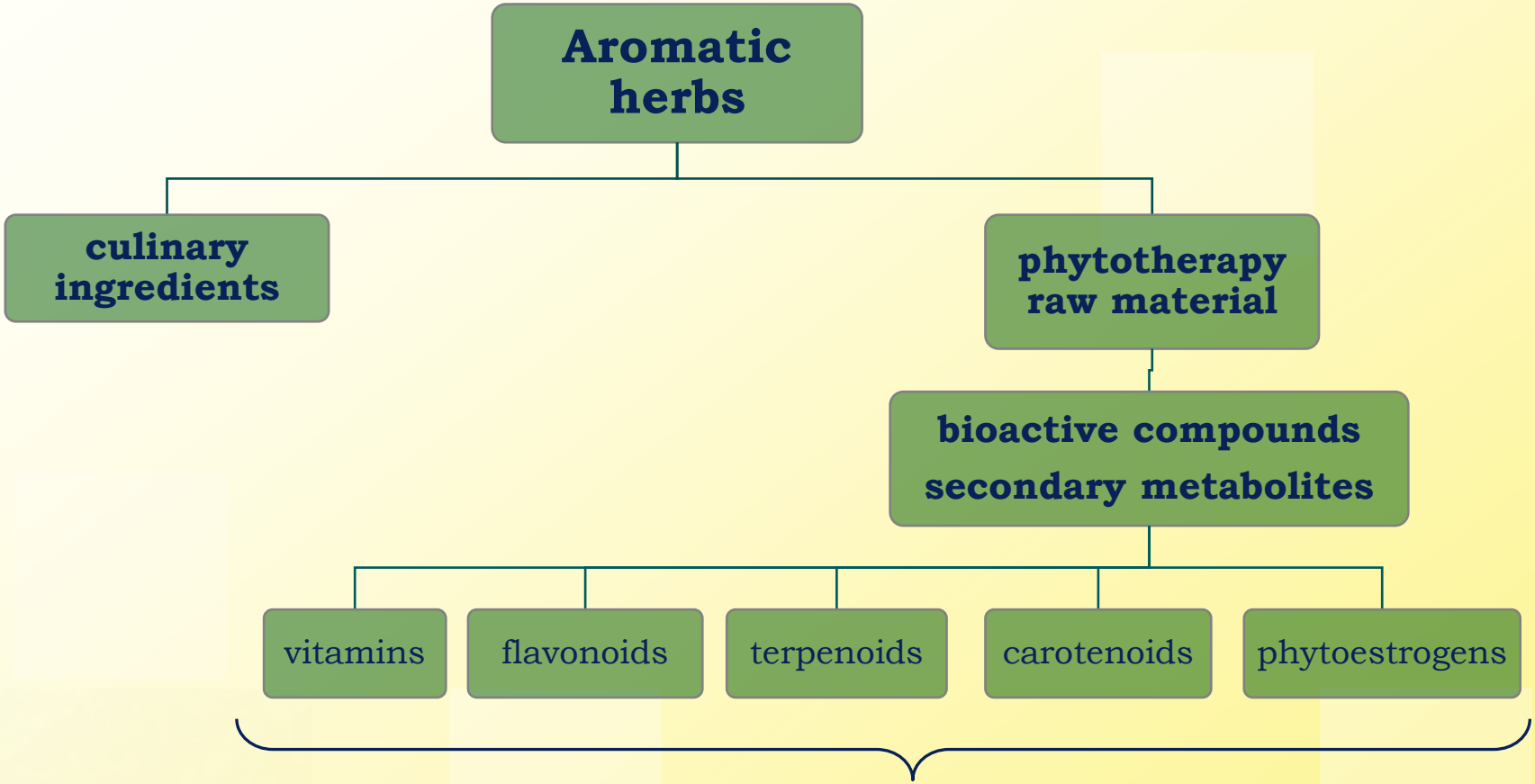
Use of Aroma Maps and Principal Components Analysis in Evaluating Changes of Volatile Aroma Compounds During Cold Storage of Minimally Processed Herbs

Giorgiana Mihaela Cătunescu*, Sonia Ancuţa Socaci*, Adriana David, Mircea Muntean, Sorin Stănilă, Florina Bunghez, Maria Tofană*



potentially beneficial biological action

- on chronic diseases
- antioxidant and antimicrobial properties

the most important components of

aromatic herbs

volatile aroma compounds (VACs)

- **protect** the **cardiovascular system** by
  - preventing lipid peroxidation
  - lowering cholesterol and triglyceride levels
  - reducing blood pressure
- **antioxidant** properties
- **antimicrobial** effects against pathogens

- improper handling and storing
- post-harvest mechanical operations

- decreases in quality
- loses of bioactive compounds (VACs)

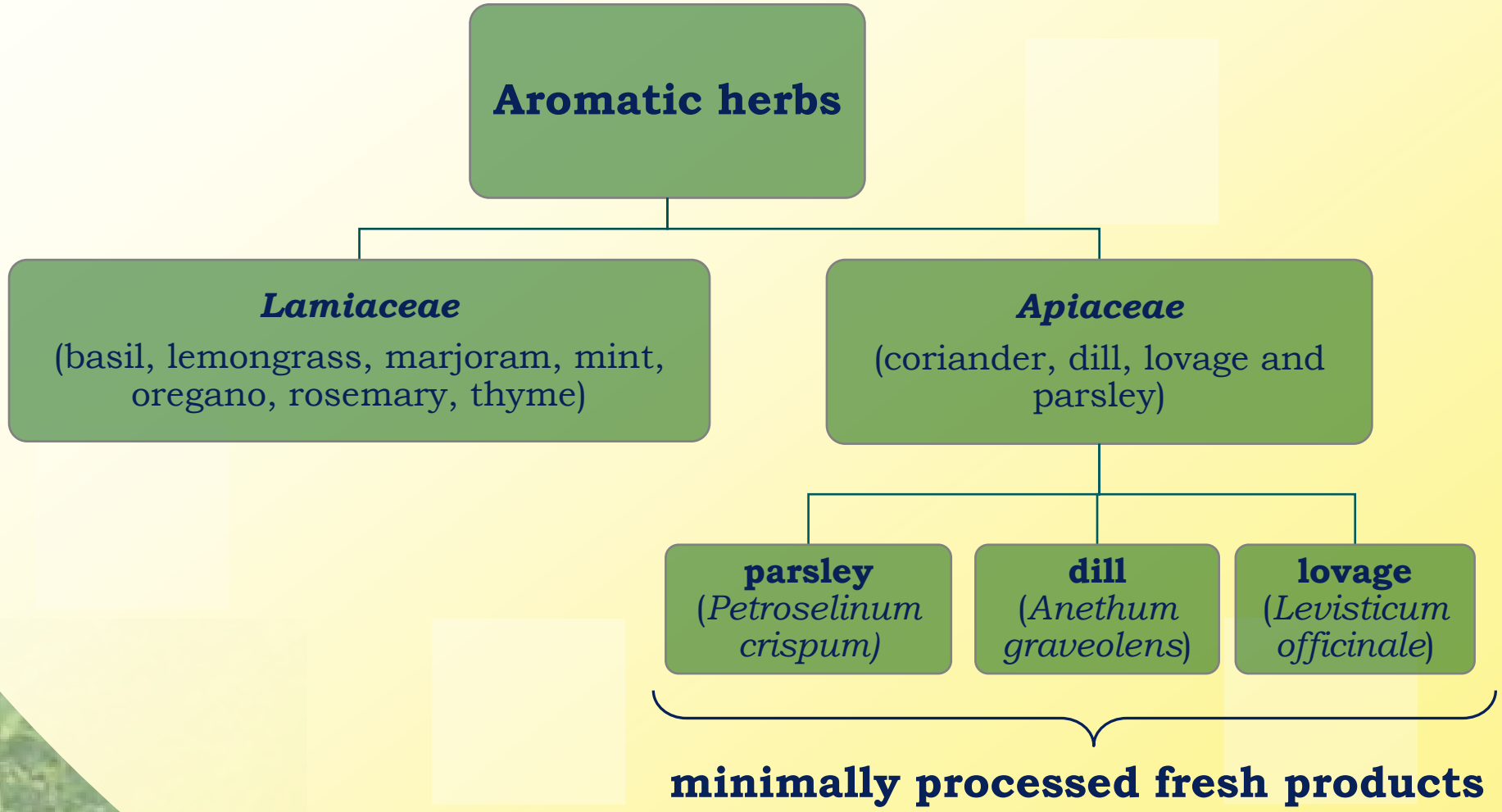
The **content** of bioactive compounds **decreases** (VACs) **with** the **number of** processing **steps.**

Minimally processed fresh products have a **growing market** worldwide.

Minimally processed fresh vegetables:

- submitted to **mild treatments**

  (washing, cutting, grating, shredding)
- provide the **convenience** demanded by consumers
- **free** of **additives**
- **no** traditional **preservation methods**
- **cold storage** (refrigeration) allowed


Aromatic herbs
Lamiaceae
(basil, lemongrass, marjoram, mint, oregano, rosemary, thyme)
Apiaceae
(coriander, dill, lovage and parsley)
parsley (Petroselinum crispum)
dill (Anethum graveolens)
lovage (Levisticum officinale)
minimally processed fresh products

The **study** of **VACs** → **large** amounts of data

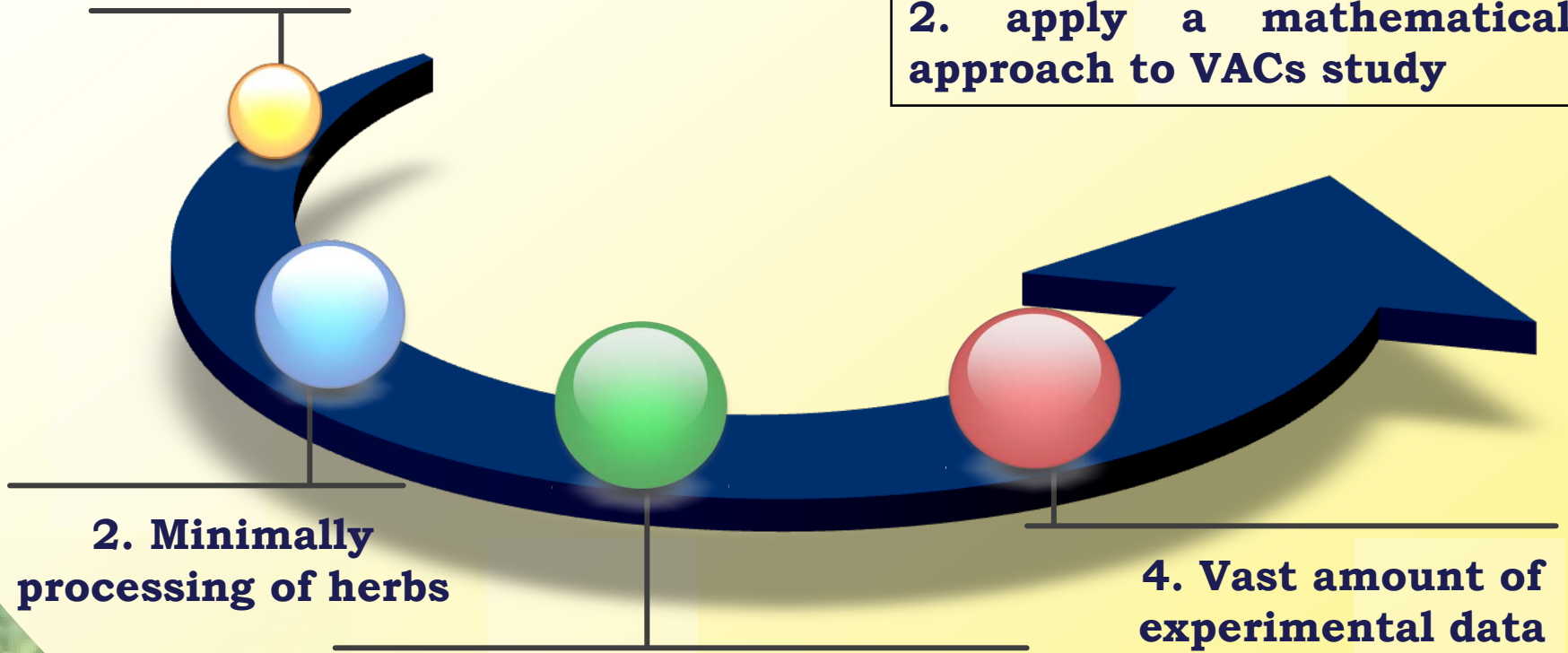
- obtain **simple representation** of the experimental results
- efficiently **reduce** spatial **dimensions** of data
- easily view the **basic structure** and **correlations** of experimental data
- **visualize at a glance** aroma particularities

Aroma Maps and **Principal Component Analysis (PCA)**

- determine the **aroma profile** of herbs
- **similarities** and **differences** among VACs of different aromatic herbs
- better understand the **variation** of VACs during storage

Aims of study

1. build original Aroma Maps
2. apply a mathematical approach to VACs study



Experimental approach

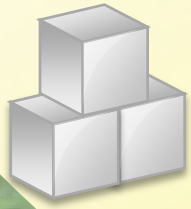
VACs analysis:

- GC-MS protocol

3-4 days

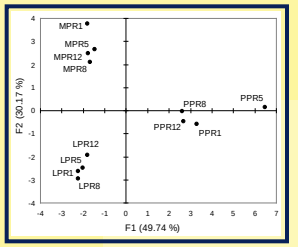
12 days

Parsley, dill, lovage



Minimal processing

Cold storage 4º C



Principal component analysis

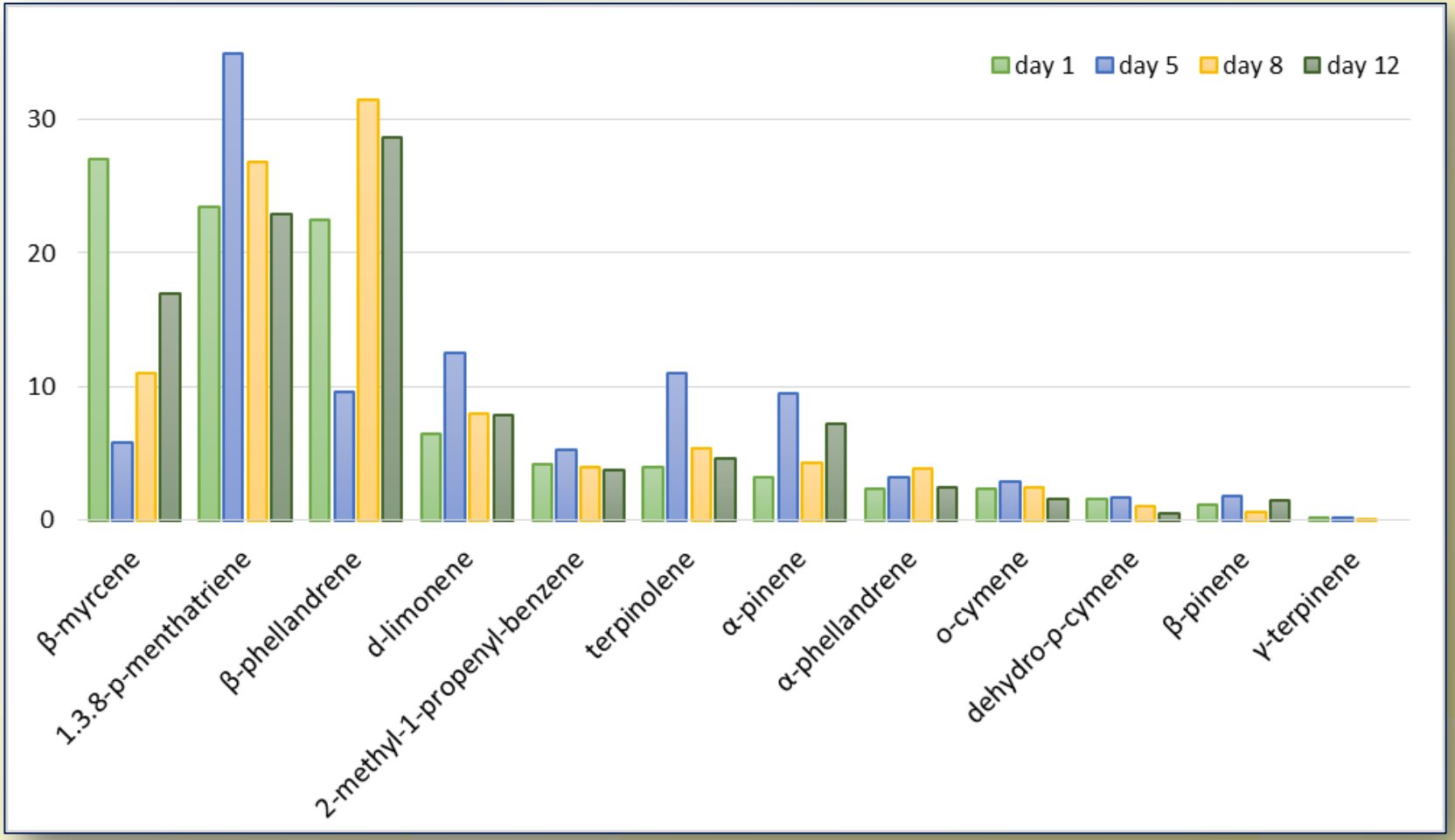


Figure 1. Evolution of volatile compounds of minimally processed parsley during storage

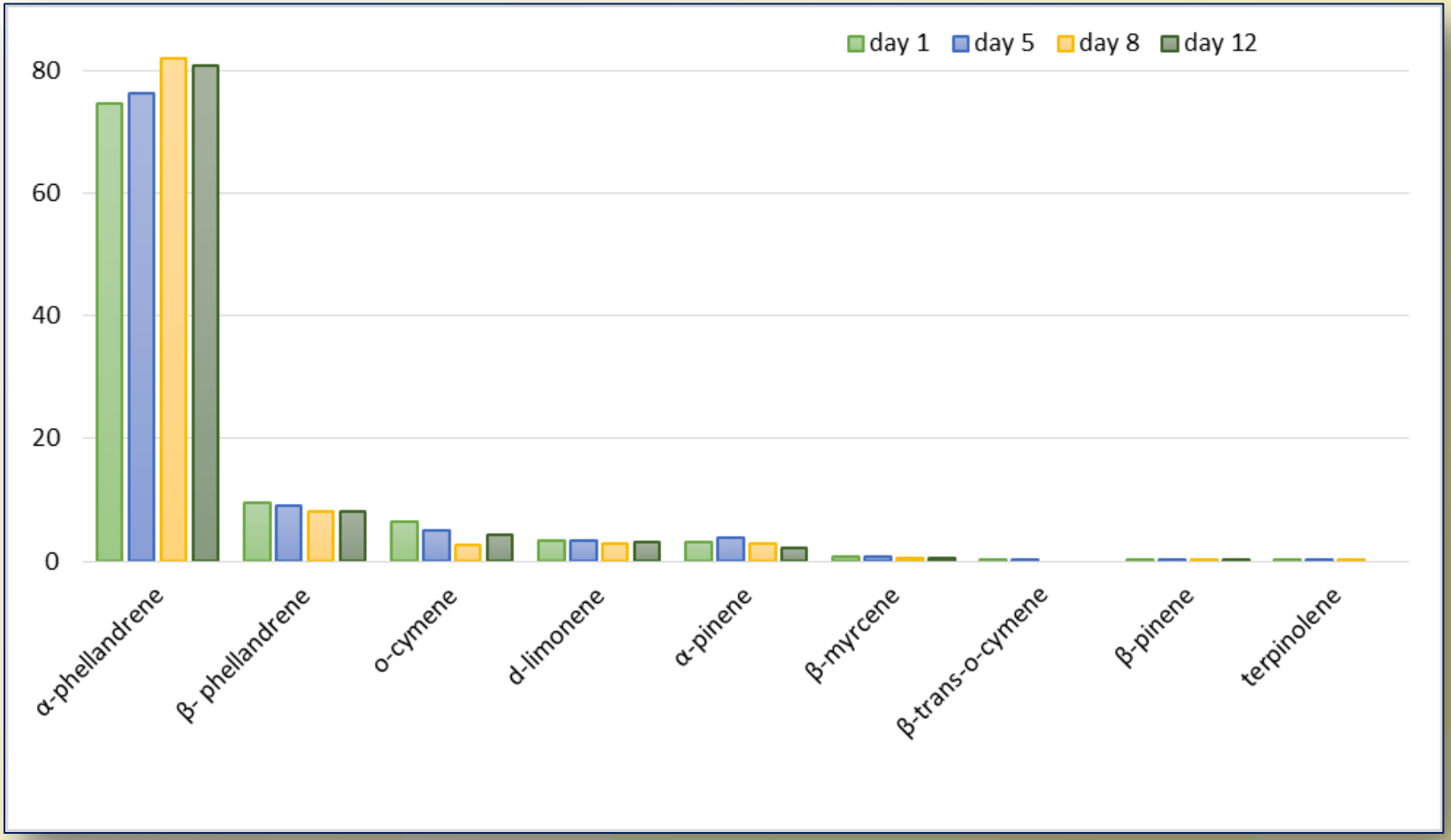


Figure 2. Evolution of volatile compounds of minimally processed dill during storage

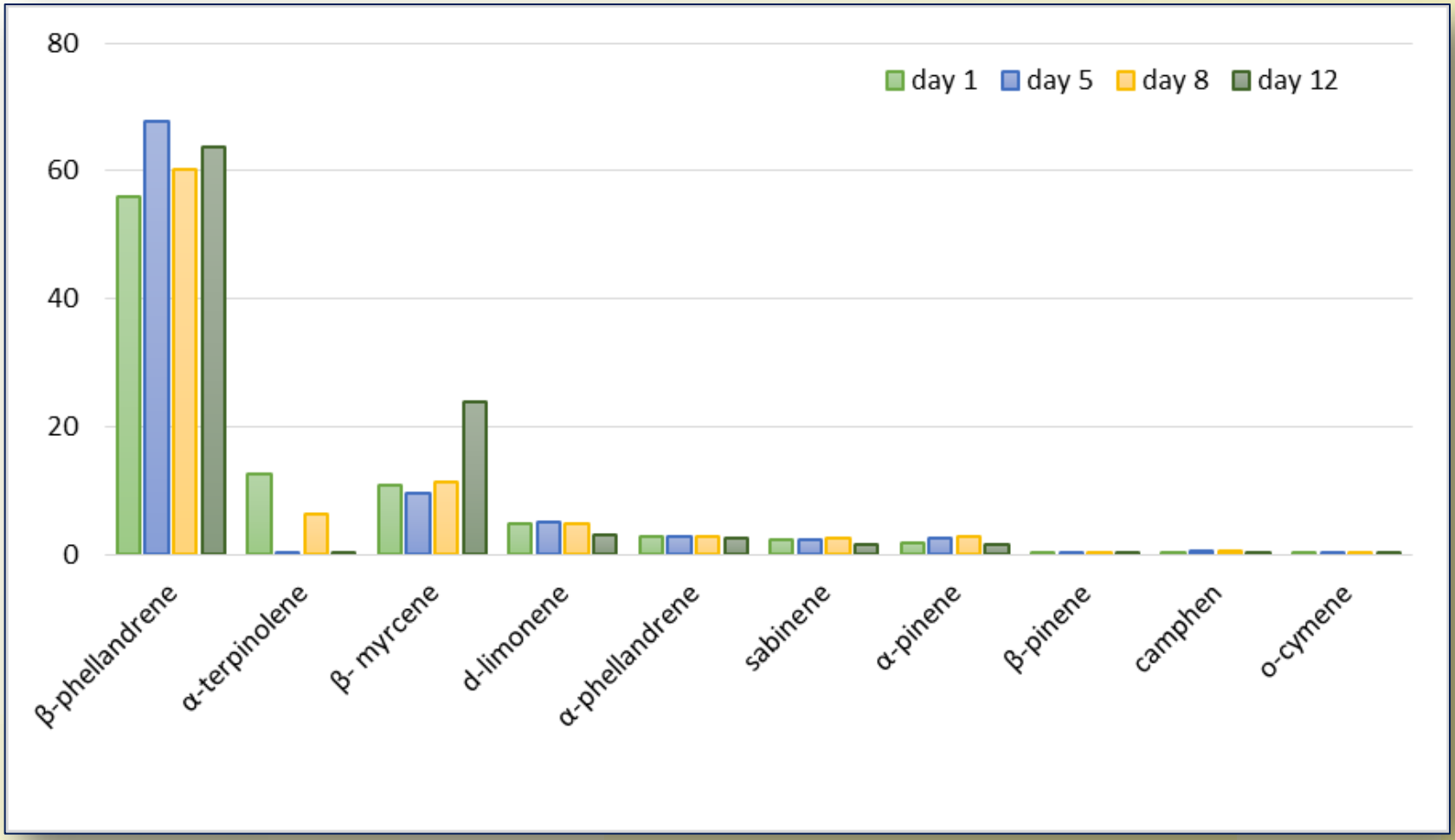
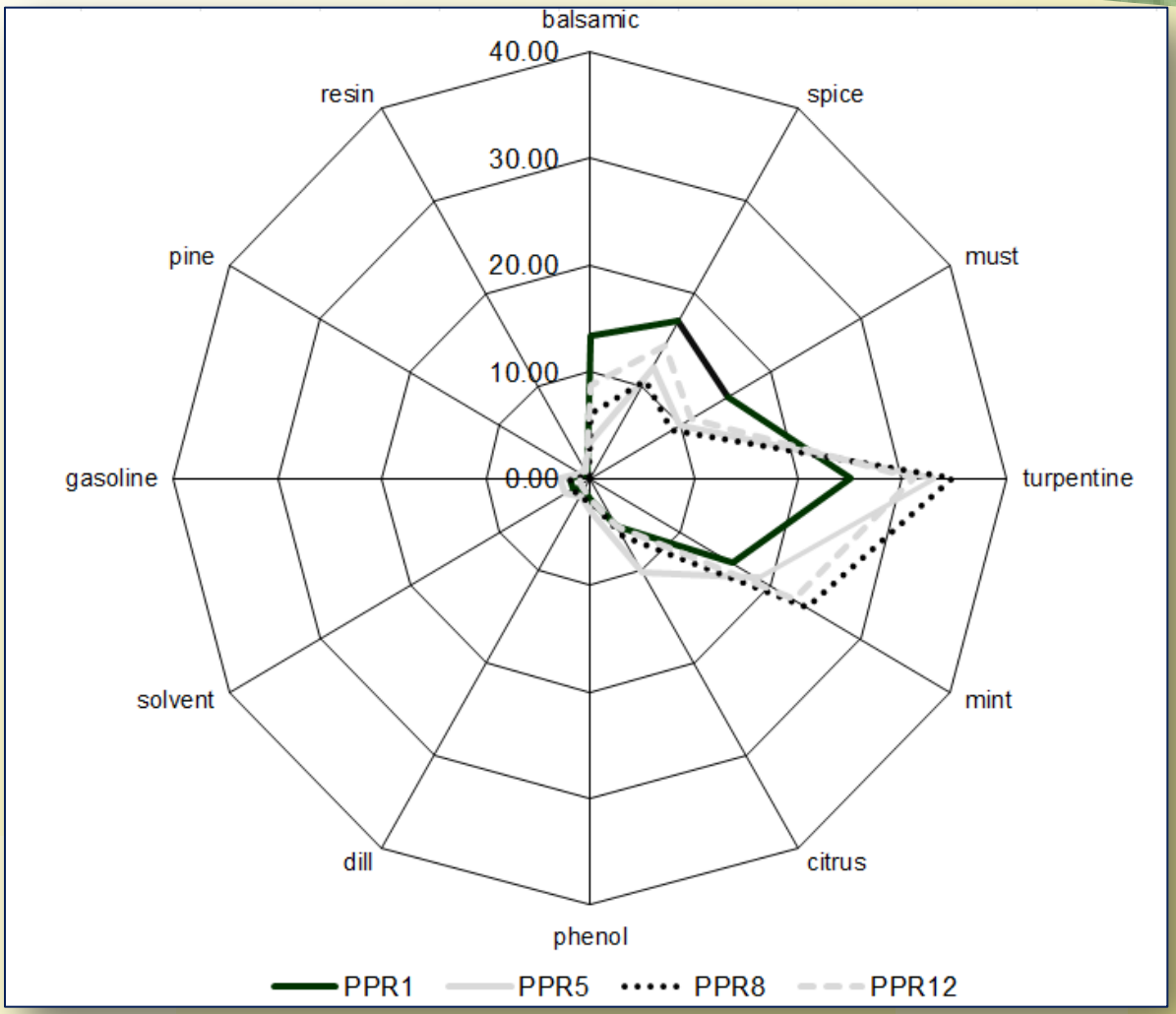


Figure 3. Evolution of volatile compounds of minimally processed lovage during storage

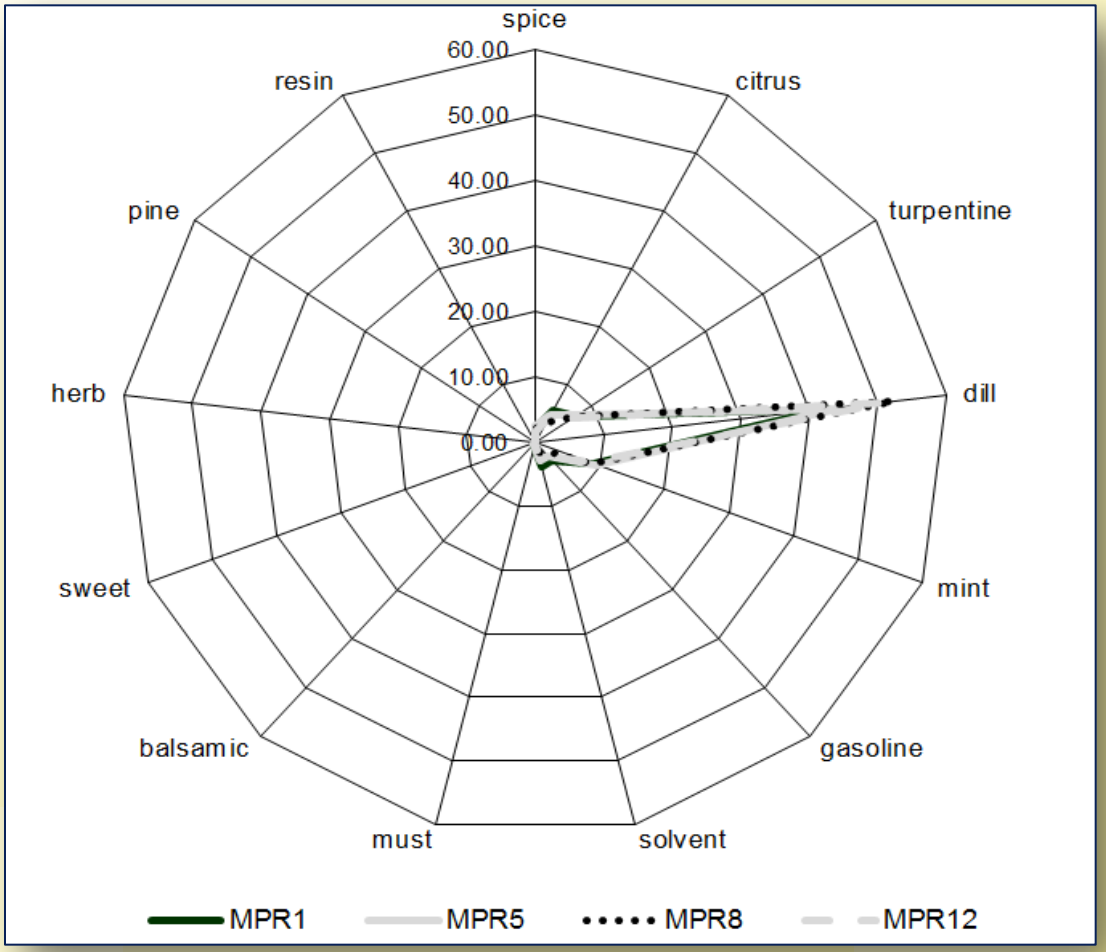
	Volatile compound	Perceived aroma*
1	β-myrcene	**balsamic, spice, must**
2	1.3.8-p-menthatriene	**turpentine**
3	β-phellandrene	**mint, turpentine**
4	d-limonene	**citrus, mint**
5	2-methyl-1-propenyl-benzene	**phenol, spice**
6	terpinolene	**must**
7	α-pinene	**turpentine, mint, spice**
8	α-phellandrene	**dill**
9	o-cymene	**solvent, gasoline, citrus**
10	dehydro-ρ-cymene	**solvent, gasoline, citrus**
11	β-pinene	**pine, resin, turpentine**
12	**γ-terpinene**	**gasoline, turpentine**



* Source: http://www.flavornet.org/flavornet.html

Figure 4. Map of perceived aroma profile along storage of minimally processed parsley

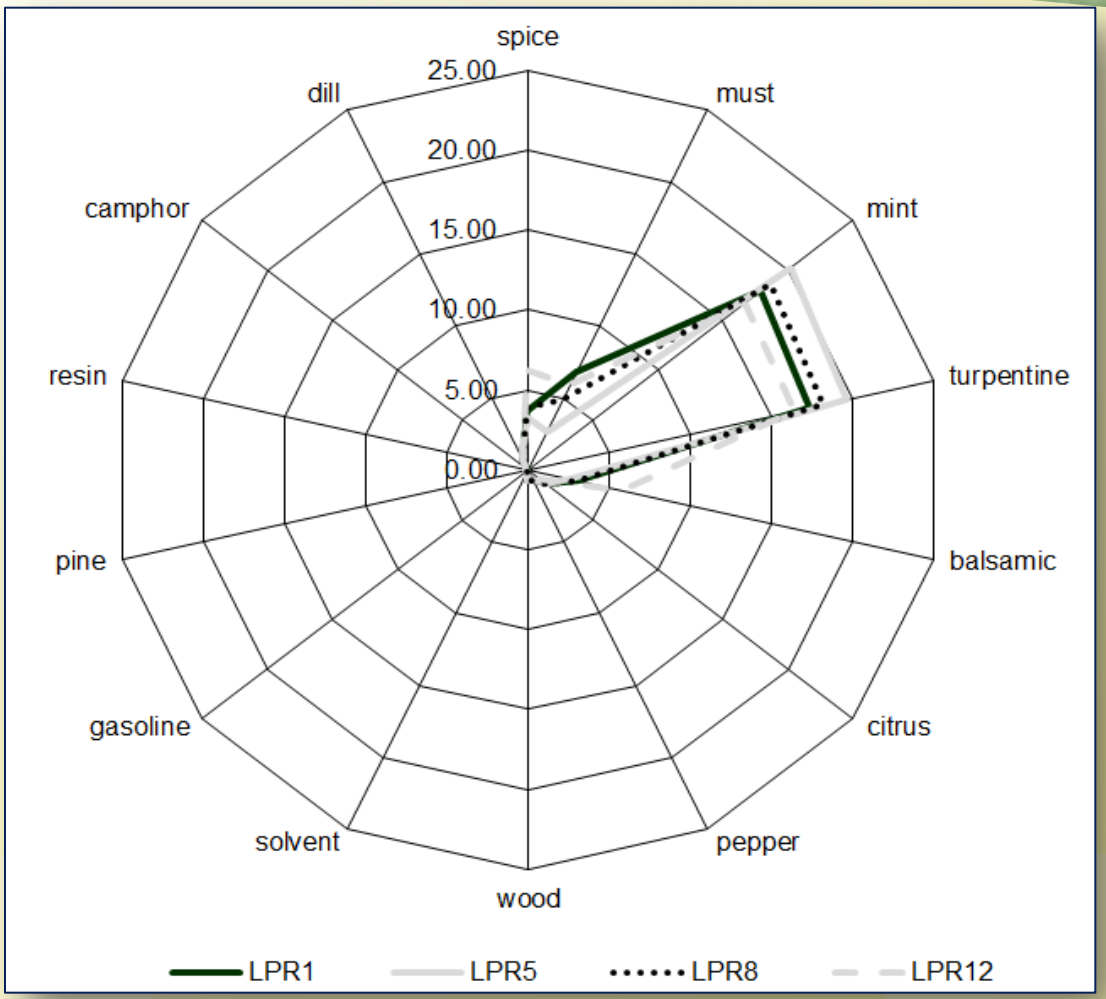
	Volatile compound	Perceived aroma*
1	α-phellandrene	**dill**
2	β- phellandrene	**mint, turpentine**
3	o-cymene	**solvent, gasoline, citrus**
4	d-limonene	**citrus, mint**
5	α-pinene	**turpentine, mint, spice**
6	β-myrcene	**balsamic, spice, must**
7	β-trans-o-cymene	**sweet, herb**
8	β-pinene	**pine, resin, turpentine**
9	**terpinolene**	**must**



* Source: http://www.flavornet.org/flavornet.html

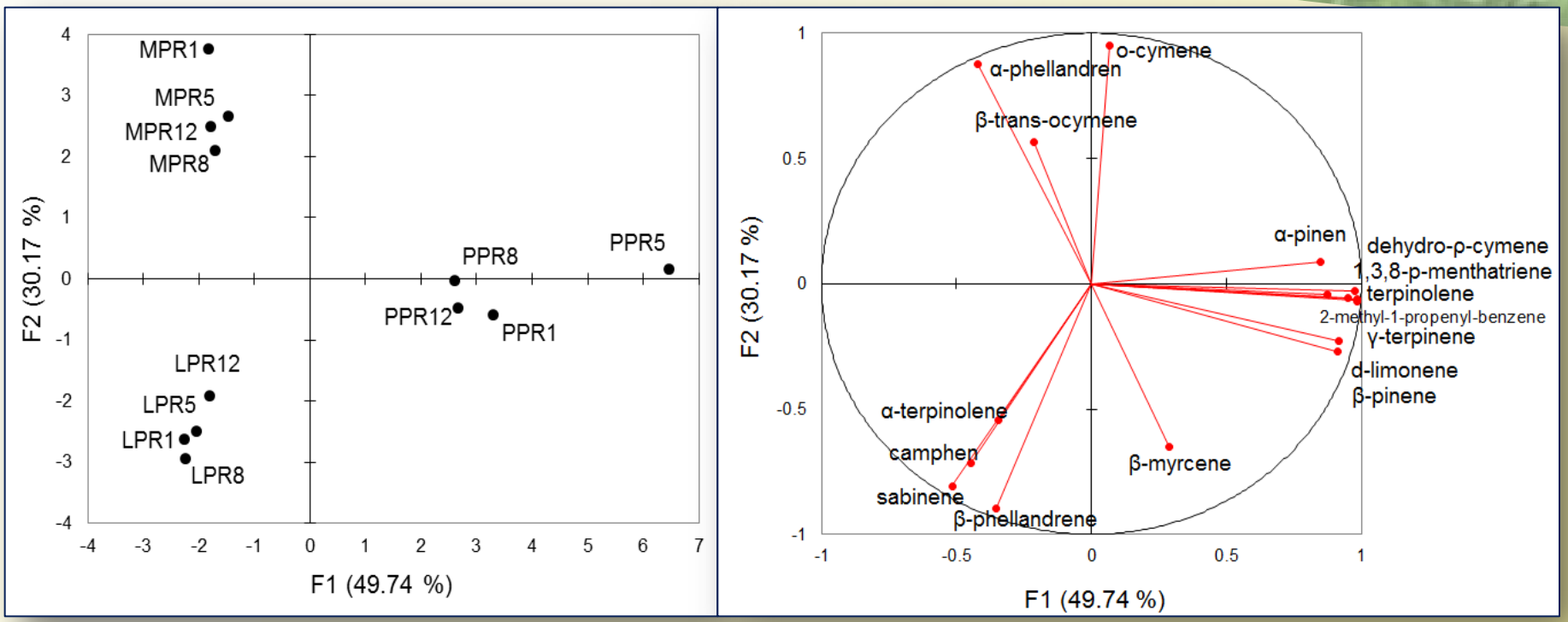
Figure 5. Map of perceived aroma profile along storage of minimally processed dill

	Volatile compound	Perceived aroma*
1	β-phellandrene	**mint, turpentine**
2	α-terpinolene	**must**
3	β- myrcene	**balsamic, spice, must**
4	d-limonene	**citrus, mint**
5	α-phellandrene	**dill**
6	sabinene	**pepper, turpentine, wood**
7	α-pinene	**turpentine, mint, spice**
8	β-pinene	**pine, resin, turpentine**
9	camphen	**camphor**
10	**o-cymene**	**solvent, turpentine, spice**



* Source: http://www.flavornet.org/flavornet.html

Figure 6. Map of perceived aroma profile along storage of minimally processed lovage



Storage day	Parsley	Dill	Lovage
1	PPR1	MPR1	LPR1
5	PPR5	MPR5	LPR5
8	PPR8	MPR8	LPR8
12	PPR12	MPR12	LPR12

F1: 1.3.8-p-menthatriene, d-limonene, 2-methyl-1-propenyl-benzene, terpinolene, dehydro-ρ-cymene, β-pinene, γ-terpinene (+)

F2: α-phellandrene, o-cymen (+)
β-phellandrene,sabinene (-)

Figure 7. PCA of volatile compounds found in minimally processed herbs along storage

1. VACs determinations can be made more conclusive by Aroma Maps, which give a more perceptible approach to VACs study.
2. PCA can be successfully applied to determine the aromatic profile for culinary herbs.
3. The use of PCA helped identifying the effect of cold storage on VACs content of minimally processed herbs, as well as, some correlations among VACs and storage period.
4. PCA can be applied to food products to evaluate the connection among quality parameters, and their evolution along storage.
5. The correlation between sensory parameters (perceived aroma) and biochemical parameters gave encouraging results on the importance of sensory perception in assessing quality changes after processing and during storage.

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Thank you for your attention!

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