Characterization of freeze-dried basil used as aromatic ingredient to enrich the nutritional quality of food

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CENTRUL DE CERCETARE PENTRU STUDIUL CALITATII PRODUSELOR AGROALIMENTARE
ECOLEGDRY

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Introduction

Due to their aromatic character, basil can be used fresh or dried to enhance the flavour of soups, vegetables, pizza, salads and other food products. The aim of this study is to determine the effect of freeze-drying on different basil varieties, which will be further used as aromatic ingredient to enrich vegetable chips.

Mat & Methods

Four varieties of organic basil (L1A Mir V, Macedon, Tulsi, and L9) were received from the Vegetable Research Development Station Buzau in October 2021. The fresh samples were separated, washed, quickly frozen at - 80˚C in order to be further freeze-dried at - 55˚C. Basil samples were analyzed immediately after freeze-drying taking in consideration the following parameters: dry matter content, ascorbic acid, total phenolic content, antioxidant activity, chlorophylls a and b, carotenoids and volatile oils.

Results - biochemical composition

Analyzing and comparing the 4 organic basil varieties, it was observed that dry matter content values are similar. Antioxidant activity of organic basil analyzed by DPPH method suggests that all four varieties can be a source of antioxidant compounds. An obvious correlation was found between the total antioxidant activity and the content of phenolic compounds. The organic basil variety "Macedon" presented the highest antioxidant activity and the highest content of phenolic compounds.

In the case of chlorophyll, there are no significant variations between varieties, both chlorophyll A and chlorophyll B being found in approximately equal amounts.

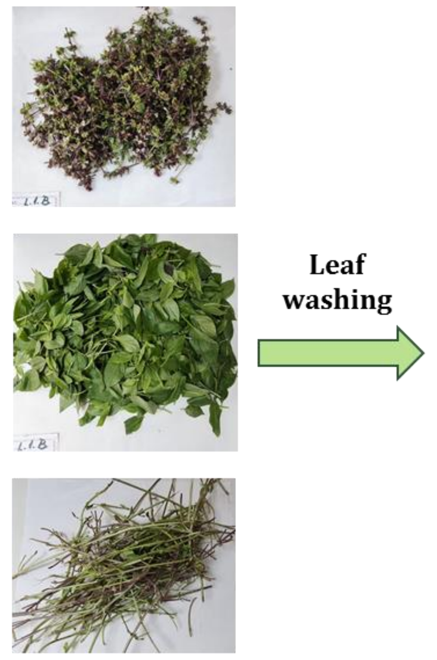
Tab. 1 Results regarding the biochemical composition of organic basil varieties

Parameter	*Ocimum basilicum* L1A Mir	*Ocimum citriodorum* Macedon	*Ocimum sanctum* Tulsi	*Ocimum basilicum f. violaceum* L9
Dry matter content (%)	96.64 ±0.07	97.25 ±0.06	96.02 ±0.09	97.74 ± 0.39
Total phenolic content (mg GAE/ 100 g)	2749.42 ± 208.34	5286.37 ± 46.65	2257.00 ± 119.80	4807.75 ± 101.78
Antioxidant activity (mg TE/ 100 g)	2100.51 ± 325.23	3585.87 ± 240.53	1625.83 ± 86.18	2864.12 ± 50.61
Ascorbic acid content (mg/100 g)	57.37 ±3.39	8.62 ± 0.65	< LOQ	25.10 ± 1.16
Chlorophyll a (mg/100g)	46.67 ±3.85	25.66 ± 0.86	49.78 ±0.12	48.27 ± 1.01
Chlorophyll b (mg/100g)	19.71 ±6.62	8.81 ± 5.61	27.75 ±9.78	25.98 ± 8.20
Total chlorophyll content (mg/100 g)	66.39 ±10.11	34.46 ± 0.67	77.53 ±0.98	74.25 ± 3.08
Carotenoids (mg/100g)	11.05 ±1.99	7.42 ± 0.51	14.09 ±0.43	14.30 ± 0.44

Results - volatile oils

Compounds	*Ocimum basilicum f. violaceum* L9 %
β-Phellandrene	0.02
1R-α-Pinene	0.69
Camphene	0.10
Sabinene	0.57
beta-pinene	1.23
1-octen-3-ol	0.31
β-Myrcene	1.39
3-Octanol	0.04
α-Phellandrene	0.04
α-Terpinene	0.10
p-Cymene	0.03
d-limonene	0.61
1,8 Cineole	6.48
trans-β-Ocimene	0.01
Benzene acetaldehyde	0.04
β-Ocimene	0.07
γ-Terpinene	0.17
cis-Sabinene hydrate	0.16
1-Octanol	0.02
Terpinolene	1.64
linalool	24.55
Camphor	0.98
Isoborneol	0.06
L-α-Terpineol	0.26
Terpinen-4-ol	0.32
α-Terpinol	1.37
Estragole	0.16
n-Octyl acetate	0.06
2-Nonen-4-one, 2-methyl-	0.26
endo-Fenchyl acetate	0.32
Nerol	0.07
Neral	0.10
cis-Geraniol	0.22
Citral	0.12
L-α-bornyl acetate	0.14
Methyl geranate	0.09
exo-2-Hydroxycineole acetate	0.09
δ-Elemene	0.38
Eugenol	16.92
alfa.-Copaene	0.26
Methyl cinnamate	5.38
β-Elemene	0.82
Methyleugenol	0.84
Isocaryophyllene	2.12
trans- α-Bergamotene	0.59
α-Guaiene	1.17
cis-β-Farnesene	0.11
cis-muurola-3,5-diene	0.27
Humulene	0.86
trans-β-Farnesene	0.64
γ-Muurolene	0.76
Germacrene D	2.37
cis-β-Farnesene	0.54
γ-Elemene	3.01
Guaia-1(10),11-diene	3.97
γ-Cadinene	2.39
δ-Cadinene	0.48
α-Bisabolene	0.24
Nerolidol	0.43
Spathulenol	0.58
Caryophyllene oxide	0.46
Cubenol	1.43
α-epi-Cadinol	8.40
β-Eudesmol	0.50
α-Cadinol	0.66
α-Bisabolol	0.25
Pytol	0.30

Compounds	*Ocimum basilicum* L1A Mir %
β-Phellandrene	0.01
1R-α-Pinene	0.18
Camphene	0.03
Sabinene	0.14
beta-pinene	0.35
1-octen-3-ol	0.23
β-Myrcene	0.21
3-Octanol	0.02
α-Phellandrene	0.01
α-Terpinene	0.04
p-Cymene	0.01
d-limonene	3.70
1,8 Cineole	0.00
trans-β-Ocimene	0.04
Benzene acetaldehyde	0.02
β-Ocimene	1.27
γ-Terpinene	0.06
cis-Sabinene hydrate	0.02
1-Octanol	0.07
Terpinolene	0.06
Linalool	8.02
Camphor	0.09
Isoborneol	0.06
L-α-Terpineol	0.13
Terpinen-4-ol	0.12
α-Terpinol	0.60
Estragole	0.02
n-Octyl acetate	0.02
2-Nonen-4-one, 2-methyl-	0.00
endo-Fenchyl acetate	0.02
Nerol	0.02
Neral	0.01
cis-Geraniol	0.29
Citral	0.01
L-α-bornyl acetate	0.12
Methyl geranate	1.21
exo-2-Hydroxycineole acetate	0.02
δ-Elemene	0.04
Eugenol	8.49
alfa.-Copaene	0.07
Methyl cinnamate	66.45
β-Elemene	0.60
Methyleugenol	0.18
Isocaryophyllene	0.22
trans- α-Bergamotene	0.05
α-Guaiene	0.23
cis-β-Farnesene	0.02
cis-muurola-3,5-diene	0.09
Humulene	0.13
trans-β-Farnesene	0.04
γ-Muurolene	0.24
Germacrene D	0.67
cis-β-Farnesene	0.09
γ-Elemene	0.47
Guaia-1(10),11-diene	0.68
γ-Cadinene	0.75
δ-Cadinene	0.11
α-Bisabolene	0.02
Nerolidol	0.03
Spathulenol	0.05
Caryophyllene oxide	0.03
Cubenol	0.34
α-epi-Cadinol	2.40
β-Eudesmol	0.03
α-Cadinol	0.14
α-Bisabolol	0.07
Pytol	0.01



Compounds	*Ocimum sanctum* Tulsi %
1R-α-Pinene	0.60
Sabinene	0.26
β-pinene	1.18
1-octen-3-ol	0.06
3-octanone	0.05
Myrcene	0.32
3-Octanol	0.05
Octanal	0.03
4-Hexen-1-ol, acetate	0.07
1,8-Cineole	10.00
trans-β-Ocimene	0.24
β-Ocimene	5.31
γ-Terpinene	0.11
cis-Sabinene hydrate	0.54
cis-Linalool oxide	0.01
Terpinolene	0.05
linalool	0.78
L-α-Terpineol	0.35
Terpinen-4-ol	0.25
α-Terpinol	1.39
Estragole	12.52
Methyl chavicol	0.31
α-Citral	0.03
Methyl (z) cinnamate	0.04
Eugenol	39.95
alfa-Copaene	0.33
Methyl (E) cinnamate	2.65
β-copaene	0.11
Methyleugenol	0.21
Isocaryophyllene	1.55
trans- α-Bergamotene	1.09
cis-β-Farnesene	0.39
Humulene	1.80
trans-β-Farnesene	0.34
Germacrene D	1.97
Neidentificat	0.27
Guaia-1(10),11-diene	0.15
β-Bisabolene	5.54
γ-Cadinene	0.21
δ-Cadinene	0.15
α-Bisabolene	6.86
Caryophyllene oxide	0.27
Humulene epoxide II	0.22
T-Cadinol	0.53
α-Bisabolol	0.88

Compounds	*Ocimum citriodorum* Macedon %
1R-α-Pinene	0.01
1-octen-3-ol	0.03
3-octanone	1.07
4-Hexen-1-ol, acetate	0.05
d-limonene	0.04
1,8 Cineole	0.13
β-Ocimene	0.09
cis-Linalool oxide	0.07
linalool	0.97
exo-Fenchol	0.19
trans-Chrysanthemal	0.67
Nerol oxide	0.07
Neidentificat	0.92
cis-Verbenol	1.30
α-Terpinol	0.35
Estragole	0.11
Nerol	1.61
Neral	23.94
Geraniol	0.45
α-Citral	29.33
Linalool acetate	0.99
Methyl (z) cinnamate	0.22
Methyl geranate	0.21
Bornyl acetate	0.22
Eugenol	4.70
Neryl acetate	0.81
alfa-Copaene	0.27
Methyl (E) cinnamate	12.13
Isocaryophyllene	2.69
trans- α-Bergamotene	0.99
cis-β-Farnesene	0.14
Humulene	0.71
trans-β-Farnesene	0.65
Germacrene D	1.02
α-Selinene	0.33
b-Bisabolene	0.54
γ-Cadinene	0.47
δ-Cadinene	0.22
α-Bisabolene	2.99
Caryophyllene oxide	4.05
Humulene epoxide II	0.97
T-Cadinol	2.03
β-Eudesmol	0.69
α-Bisabolol	0.54

Fig. 1 Results regarding the volatile oils composition of organic basil

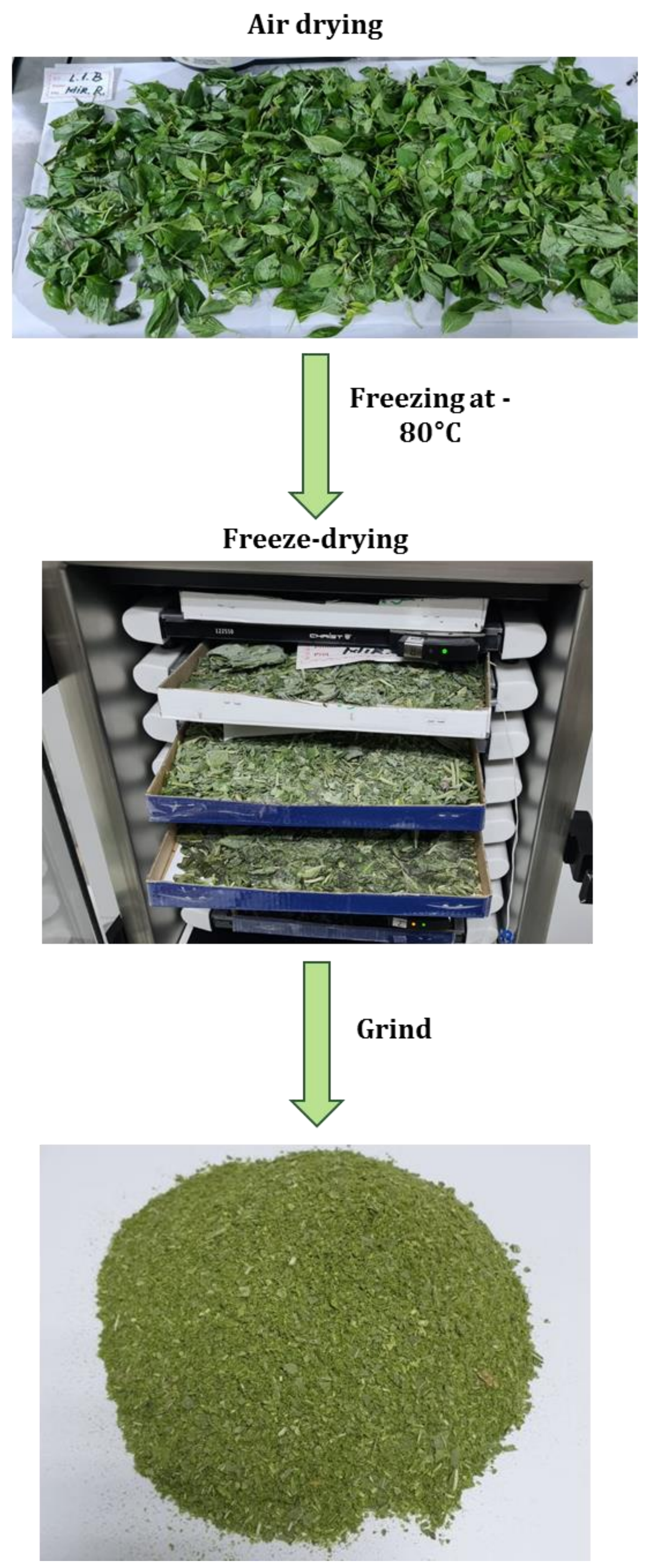


Fig. 2 Obtaining organic basil powder by freeze-drying process

The essential oils from organic basil varieties analyzed vary from the point of view of chemical composition. Comparing the four organic basil varieties, it was observed differences between predominant compounds. In the *Ocimum basilicum f. Violaceum* volatile oil, the predominant compounds are linalool, eugenol, methyl cinnamate, 1,8-cineole, α-epi-Cadinol. Linalool being predominant with a value of 24.55%. For *Ocimum basilicum* - variant L1A Mir V, the predominant compounds are methyl cinnamate, linalool, eugenol, the highest percentage with a percentage value of 66.45% being methyl cinnamate. When analyzing the other species, much bigger differences are observed compared to *Ocimum basilicum*, for example *Ocimum sanctum* - Tulsi and *Ocimum citriodorum* - Macedon have in their component Eugenol - 39.95% in the Tulsi variety, respectively α-Citral 29.33% and Neral 23.94% for the Macedon variety.

Conclusions and perspective

'Macedon' variety registered the one of the highest content of polyphenols and antioxidant activity. 'Tulsi' variety registered the lowest content of ascorbic acid compared to the other 3 tested varieties. The major compound found in the volatile oil, when red variety was analyzed was d-limonene.

Based on the results obtained in the analysis of volatile oils, it can be stated that the species identification can also be done with the help of the biochemical composition, especially of the compounds from the volatile oils.

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