MILESTONE
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APPLICATION REPORT

EX08 - LAVANDER FLAVORS

Lavander Microwave Hydrodiffusion and Gravity (MHG)

Introduction

Lavender is one of the most useful medicinal plants. Commercially, the lavender provides several important essential oils to the fragrance industry, including soaps, colognes, perfumes, skin lotions and other cosmetics. In food manufacturing, lavender essential oil is employed in flavouring beverages, ice cream, candy, baked goods and chewing gum. The essential oils of Lavandula species are obtained by steam distillation of the fresh flowering spikes. Oil quality is assessed by oil chemical composition and by the organoleptic opinion. In addition, a large range of medical uses for this plant have also been reported. These include antispasmodic, sedative, antihypertensive, antiseptic, healing and anti-inflammatory properties, all of which render it highly appreciated in phytotherapy and aromatherapy. In food manufacturing, lavander essential oil has been employed in flavoring beverages, ice cream, baked goods and chewing gum [1].

[1] F. Chemat, M. Lucchesi, J. Smadja, L. Favretto, G. Colnaghi, F. Visinoni, Analytica Chimica Acta 2006, 555, 157-160.

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Why to choose Microwave Flavor set-up?

The patented and revolutionary Microwave Hydrodiffusion and Gravity (MHG) system pays the way to new flavoring products which were impossible to be obtained with the ancient extraction concepts. Percolation, solvent extraction ecc… were inefficient and environmental-unfriendly methods of flavor extraction. MHG is going to improve the efficiency and the quality of flavoring products.

- New natural flavors
- Fast extraction
- No thermal degradation
- No solvent

Instrumentation and Principles of Operation

A very efficient extraction process can be achieved thanks to the selective heating of microwaves to materials through molecular interactions with the electromagnetic field via conversions of electromagnetic energy into thermal energy. The high quality fragrance were obtained through the MHG techniques (see the “Microwave Extraction Techniques” section for theory and principle).

Results and experimental procedure

The MHG technique is suitable for both dry and fresh raw material, see the “Quick start guide” for a list of easy and sequential setting-up operations (*Table 1*).

Fresh Lavander (MHG)

Reactor	Weighted fresh raw material [g]*	Power [W]	Chiller		Total flavour extract [mL]	Volatile fraction [mL]	Total flavor extract yield [%]
			1kW	2.1kW			
Small	1000	1000	•		360	6	36
Medium	3160	1800		•	950	20	30.1
Large	7445	1800		•	2500	39	33.6

Dry Lavander (MHG)

Reactor	Weighted fresh raw material [g]*	Power [W]	Chiller		Total flavour extract [mL]	Volatile fraction [mL]	Total flavor extract yield [%]
			1 kW	2.1kW			
Small	1000	1000	•		285	4.8	28.5
Medium	3160	1800		•	882	15.2	27.9
Large	7445	1800		•	2144	35.7	28.8

*Time, Power
≤ 1800 g: Power(W) = Weight(g) for 20 min.
> 1800g: Power = 1800W for 40min
Chiller settings:
≤ 900g, 1 kW Chiller
> 900g, 2.1 kW Chiller

Table 1

Important remarks

Please take into account that the interaction between microwaves and raw material is based on the water content. The optimized method (power and time) depends on the type of lavander, mainly to the water content of lavanda itself. Please use the reported parameter as general application note to start to optimize your own method. Be careful, that using an excess power might cause burning of your sample.

Please take care to seal properly the glass reactor during the installation of the flavors set-up according to the manual, to avoid loss of vapor during extraction.

Conclusion

A newly and cleaner design process for extraction of flavors was developed in this study: MHG. This green process has been studied and tested using lavander flowers. This new system was developed to date indicate that microwave extraction process of flavors offers important advantages over antiquated extraction techniques, namely, shorter extraction times, less energy consuming, lower costs as well as new flavoring products. The MHG system offers furthermore the possibility to work with scalar amounts of sample due to three different reactor vessels (small, medium, large), complying with a high range of extraction-scale needs.

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EX09 - LAVANDER FRAGRANCES

Lavander Solvent-Free Microwave Extraction (SFME) and Microwave Hydrodistillation (MWHD)

Introduction

Lavender is one of the most useful medicinal plants. Commercially, the lavender provides several important essential oils to the fragrance industry, including soaps, colognes, perfumes, skin lotions and other cosmetics. In food manufacturing, lavender essential oil is employed in flavouring beverages, ice cream, candy, baked goods and chewing gum. The essential oils of Lavandula species are obtained by steam distillation of the fresh flowering spikes. Oil quality is assessed by oil chemical composition and by the organoleptic opinion. In addition, a large range of medical uses for this plant have also been reported. These include antispasmodic, sedative, antihypertensive, antiseptic, healing and anti-inflammatory properties, all of which render it highly appreciated in phytotherapy and aromatherapy. In food manufacturing, lavander essential oil has been employed in flavoring beverages, ice cream, baked goods and chewing gum [1].

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[1] F. Chemat, M. Lucchesi, J. Smadja, L. Favretto, G. Colnaghi, F. Visinoni, Analytica Chimica Acta 2006, 555, 157-160.

Why to choose Microwave Fragrances set-up?

The standard method is the Clavenger method, which was published for the first time in 1928. According to that method, the essential oil from Lavander can be extracted by hydrodistillation or steam distillation. These techniques take several hours of heating which may cause degradation of thermolabile compounds present in the starting plant material and therefore odor deterioration. The patented and innovative Microwave Hydrodistillation (MWHD) and Solvent-free Microwave Extraction (SFME) techniques allow the production of essential oils with higher quality.

- High quality frangrances
- No thermal degradation
- Fast extraction
- High purity, no artifacts

Instrumentation and Principles of Operation

A very efficient extraction process can be achieved thanks to the selective heating of microwaves to materials through molecular interactions with the electromagnetic field via conversions of electromagnetic energy into thermal energy. The high quality fragrance were obtained through the SFME or MWHD techniques (see the “Microwave Extraction Techniques” section for theory and principle).

Results and experimental procedure

The SFME and the MWHD techniques are respectively suitable for fresh and dry raw materials. See the “Quick start guide” for a list of easy and sequential setting-up operations (*Table 2*).

Fresh Lavander, SFME						
Reactor	Weighted fresh raw material [g]*	Power [W]	Chiller		Volatile fraction [mL]	Yield [%]
			1kW	2.1kW		
Small	1000	1000	•		2.5	0.25
Medium	3160	1800		•	6.7	0.21
Large	7445	1800		•	15	0.22

Dry Lavander, MWHD						
Reactor	Weighted dry soaked material [g]*	Power [W]	Chiller		Volatile fraction [mL]	Yield [%]
			1 kW	2.1kW		
Small	1000	1000	•		1.7	0.17
Medium	3160	1800		•	6.6	0.21
Large	7445	1800		•	14.2	0.19

*Time, Power
The extractions were carried out till complete recovery of the fragrance
≤ 1800 g: Power(W) = Weight(g).
> 1800g: Power = 1800W
Chiller settings:
≤ 900g, 1 kW Chiller
> 900g, 2.1 kW Chiller

Table 2

Important remarks

The system is developed with an automatic recirculation of the distilled water. This allows to manage extraction power and time to match your own specific requirements. Please take care to seal properly the glass reactor during the installation of the flavors set-up according to the manual, to avoid loss of vapor during extraction.

Conclusion

In this study, we propose state-of-the-art processes for extraction of essential oils from Lavander through SFME and MWHD. It is the unique modern concept of the antiquated Clavenger method, highly accelerating the isolation process, without causing changes in the volatile oil composition. The efficiency of the new techniques SFME and MWHD are considerably higher than the conventional procedure, if we take into account short distillation times required, cost and energy used and cleanliness of the process. An added-value feature is the possibility to work with scalar amounts of sample due to three different reactor vessels (small, medium, large), complying with a high range of extraction-scale needs.

No.	Compounds	R.R.I.[a]	MWHD[b] (%)
	Monoterpenes		3.54
1	α-Thujene	907	0.08
2	α-Pinene	914	0.51
3	Camphene	933	0.32
4	Sabinene	963	0.14
5	β-Pinene	968	0.59
6	β-Myrcene	985	0.50
7	3-Carene	1008	0.22
8	Limonene	1024	tr.
9	(Z)-β-Ocimene	1031	0.33
10	(E)-β-Ocimene	1040	0.37
11	γ-Terpinene	1050	0.09
12	Terpinolene	1078	0.37
	Oxygenated monoterpenes		78.29
13	1,8-Cineole	1027	7.23
14	Sabinene hydrate-cis	1058	0.66
15	Linalool	1099	47.82
16	Camphor	1137	11.82
17	Borneol	1161	4.15
18	Terpin-4-ol	1174	5.94
19	ρ-Cymen-8-ol	1179	tr.
20	α-Terpineol	1186	0.68
	Sesquiterpenes		2.77
21	α-Bergamotene cis	1400	0.10
22	β-Caryophyllene	1412	1.28

Table 3. Yields, extraction times, grouped compounds and chemical compositions of essential oils obtained by MWHD from lavender flowers

No.	Compounds	R.R.I.[a]	MWHD[b] (%)
23	α-Santalene	1414	0.15
24	(E)-β-Farnesene	1453	0.63
25	Sesquiterpene 1	1474	0.61
	Oxygenated sesquiterpenes		0.29
26	Caryophyllene oxide	1573	0.11
27	α-Bisabolol	1677	0.18
	Other oxygenated compounds		15.01
28	Octan-3-one	977	0.78
29	Octan-3-ol	990	0.26
30	Dihydromyrcenol	1063	0.34
31	n.i.	1141	0.37
32	n.i.	1188	2.00
33	n.i.	1232	0.43
34	Linalool acetate	1254	10.74
35	Geranyl acetate	1377	0.08
	Yield (%)		8.86
	Total extraction time (min)		10
	Heating time from 20 to 100 °C (min)		5
	Real extraction time (min)		5

tr., trace; n.i., non-identified.
[a] R.R.I., relative retention indices relative to C_8–C_{22} n-alkanes on SBP5™ capillary column.
[b] MWHD, microwave hydrodistillation.

Table 3 (continued).