MILESTONE
HELPING CHEMISTS

APPLICATION REPORT

EX03 - FRANKINCENSE FRAGRANCES

Hydrodistillation (MWHD)

Introduction

Gum resins from Boswellia species, also known as frankincense, have been used as a major ingredient in Ayurvedic and Chinese medicine to treat a variety of health-related conditions. Both frankincense chemical extracts and essential oil prepared from Boswellia species gum resins exhibit anti-neoplastic activity, and have been investigated as potential anti-cancer agents. The anti-cancer activity is mediated through multiple signaling pathways. In addition, frankincense essential oil overcomes multicellular resistant and invasive phenotypes of human breast cancer cells. Fast and green Extraction of Frankincense essential oil turns out therefore to be extremely important. This essential oil is obtained from a resin from the bark of a shrub originally from the area surrounding the Red Sea, in Somalia and Arabia. To collect the resin, fine incisions are made in the bark, and drops of sap appear and dry in large, odorous yellow droplets[1].

[1] X. Ni, M. Suhail, Q. Yang, A. Cao, K.-M. Fung, R. Postier, C. Woolley, G. Young, J. Zhang, H.-K. Lin, BMC Complementary and Alternative Medicine 2012, 12.

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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 Frankincense 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) technique allows 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 1*).

Frankincense, MWHD						
Reactor	Weighted dry material + added water [g]*	Power [W]	Chiller		Volatile fraction [mL]	Yield [%]
			1 kW	2.1kW		
Small	1050	1050	•		5.5	0.52
Medium	3318	1800		•	17.6	0.53
Large	7816	1800		•	43.8	0.56

*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 1

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 fragrances 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 Frankincense resin 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.

RRI	Compounds	Boswellia rivae (%)
1032	α-Pinene	5.3
1035	α-Thujene	1.3
1076	Camphene	0.1
1118	β-Pinene	0.6
1132	Sabinene	1.2
1159	δ-3-Carene	9.6
1187	o-Cymene	2.5
1203	Limonene	14.8
1213	1,8-Cineole	0.3
1266	(E)-β-Ocimene	0.4
1278	m-Cymene	0.4
1280	p-Cymene	2.9
1424	o-Methylanisol	0.2
1430	α-Thujone	0.1
1439	γ-Campholene aldehyde	0.1
1444	2,5-Dimethylstyrene	0.2
1450	trans-Linalool oxide	0.1
1451	β-Thujone	0.7
1458	cis-1,2-Limonene epoxide	4.6
1468	trans-1,2-Limonene epoxide	0.5
1474	trans-Sabinene hydrate	0.9
1478	cis-Linalool oxide	0.1
1498	(E)-β-Ocimene epoxide	0.2
1499	α-Campholene aldehyde	0.9
1536	Pinocamphone	0.3
1553	Linalool	0.2
1556	cis-Sabinene hydrate	0.9
1565	8,9-Limonene epoxide-I	0.6
1571	8,9-Limonene epoxide-II	0.6
1586	Pinocarvone	0.5
1597	Bornyl acetate	0.4
1600	β-Elemene	0.3
1611	Terpinen-4-ol	1.4
1524	trans-Dihydrocarvone	0.2
1639	trans-p-Mentha-2,8-diene-1-ol	3.9
1642	Thuj-3-en-10-al	0.2
1648	Myrtenal	0.5
1651	Sabinaketone	0.2
1657	Umbellulone	0.1
1663	cis-Verbenol	0.5
1664	trans-Pinocarveol	2.2
1678	cis-p-Mentha-2,8-diene-1-ol	0.9
1683	trans-Verbenol	6.8
1700	p-Mentha-1,8-diene-4-ol	0.4
1706	α-Terpineol	1.4
1709	α-Terpinyl acetate	1.0
1720	trans-Sabinol	0.3
1725	Verbenone	4.3
1751	Carvone	1.6
1804	Myrtenol	0.7
1811	trans-p-Mentha-1(7),8-diene-2-ol	0.3
1845	trans-Carveol	2.5
1856	m-Cymen-8-ol	3.1
1864	p-Cymen-8-ol	2.0
1882	cis-Carveol	0.7
1896	cis-p-Mentha-1(7),8-diene-2-ol	0.2
1949	Piperitenone	0.6
2113	Cumin alcohol	0.1
2198	Thymol	0.1
2239	Carvacrol	0.1
	Total	88.1

Table 2. The composition of Boswellia Rivae essential oil