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Application News

GCMS-QP2050 Single Quadrupole Gas Chromatography Mass Spectrometer
Smart Aroma Database™

How Long Does A Perfume Last on Skin? – Fragrance Analysis by GCMS-QP2050 and Smart Aroma Database™

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User Benefits

- Achieve highly accurate and reproducible analysis of aroma compounds on human skin, ensuring reliable data for evaluating perfume performance.
- Smart Aroma Database simplifies the qualitative and quantitative analysis process, reducing the time and effort required for data interpretation.

Introduction

The duration on how long fragrance lasts on human skin is a critical factor in the development and evaluation of perfumes. Gas Chromatography Mass Spectrometry (GC-MS) is a powerful analytical technique that allows for the detailed analysis of volatile and semi-volatile compounds, making it an ideal tool for studying fragrance.

In this application note, a study was performed to examine fragrance on human skin at different durations after applying a perfume. Here, we explore the use of a Monolithic Material Sorptive Extraction (MMSE) MonoTrap, a sorptive extraction device to extract fragrance from human skin, followed by analysis using Shimadzu GCMS-QP2050 (Fig.1). Additionally, Smart Aroma Database was used to simplify the method development.

Experimental

Instrumental and Analytical Conditions

GCMS-QP2050 (Shimadzu Corporation, Japan) was employed in this work (Fig. 1). The details of the system configuration is shown in Table 1. Sample acquisition was done by following the analytical method from Shimadzu Smart Aroma Database. MonoTrap SG DCC18 was purchased from GL Sciences, Japan (catalog no. 1050-70002).

Table 1 Analytical System Configuration

Instrumentation	
GC-MS system	GCMS-QP2050 with Brevis™ GC
Turbo Molecular Pump Capacity	60 L/sec
Auto sampler	AOC™-30i
Column	InertCap Pure-WAX 30 m x 0.25 mmID x 0.25 µm
Acquisition Software	LabSolutions GCMS
MS Acquisition Mode	Scan Mode (For Qualitative) SIM mode (For Relative Comparison)
Database	Smart Aroma Database

Preparation of Perfume Sample for Qualitative Analysis

Perfume sample was 100 times diluted with acetone and subsequently subjected to GC-MS analysis (scan mode) for aroma compounds identification.

Fig. 1 GCMS-QP2050 with Brevis™ GC and AOC™-30i

On-skin Fragrance Sampling

The sampling procedure began with washing the arm using non-fragrance hand soap, followed by pipetting a perfume on 3 different spots on the arm (10 µl each). Fig. 2 describes the sampling procedure, while Fig. 3 shows the MonoTrap placement during the on-skin sampling procedure. Finally, 1 µL of the extracted solution was subjected to GC-MS analysis.

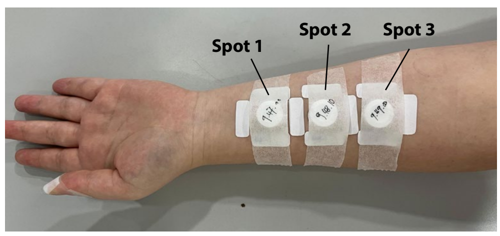

Fig. 3 MonoTrap Placement During On-skin Sampling

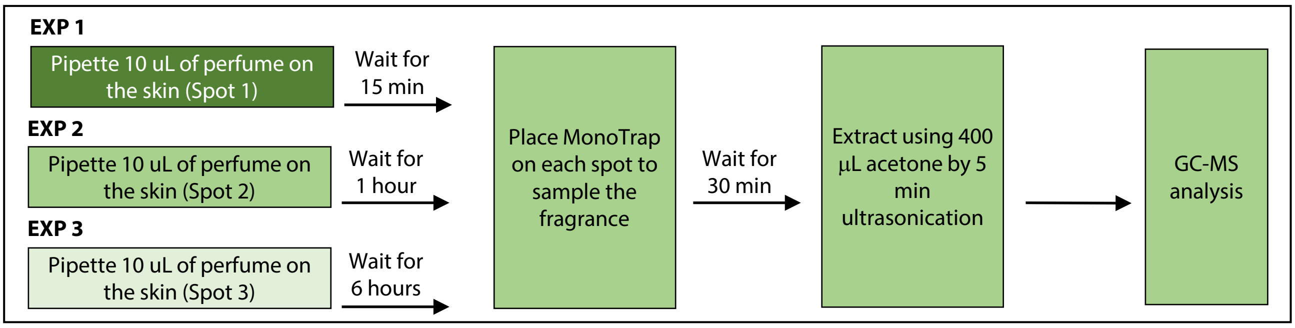

Fig. 2 On-skin Fragrance Sampling Procedure

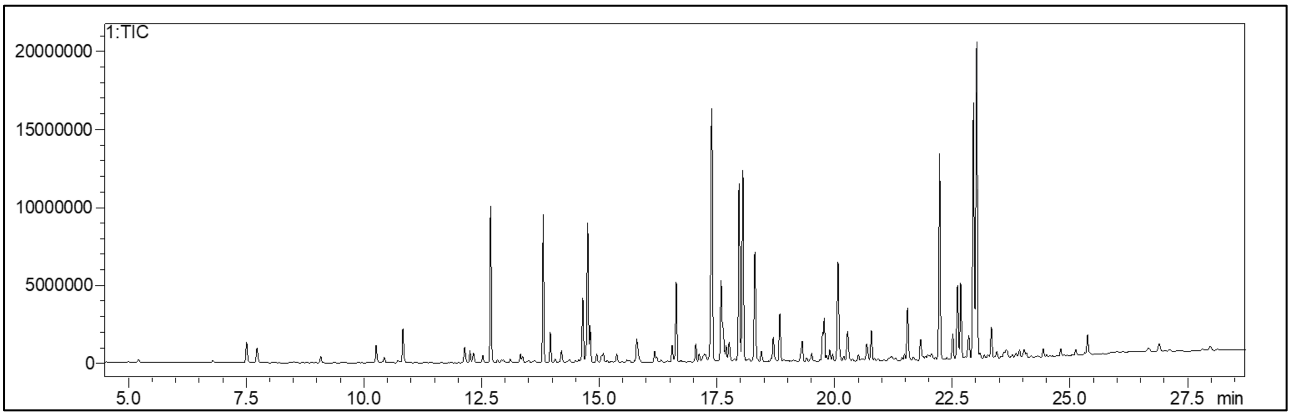

Fig. 4 Total Ion Chromatogram of the 1 µL Injection of the Diluted Perfume Sample.

■ Results & Discussion

Fragrance Compounds Detection

The scan total ion chromatogram (TIC) of the diluted perfume sample is shown in Fig. 4. A total of 60 out of the 498 fragrance compounds in Smart Aroma Database were detected. These compounds were then monitored for this study. Fig. 5 shows a few mass chromatograms of the monitored fragrance compounds.

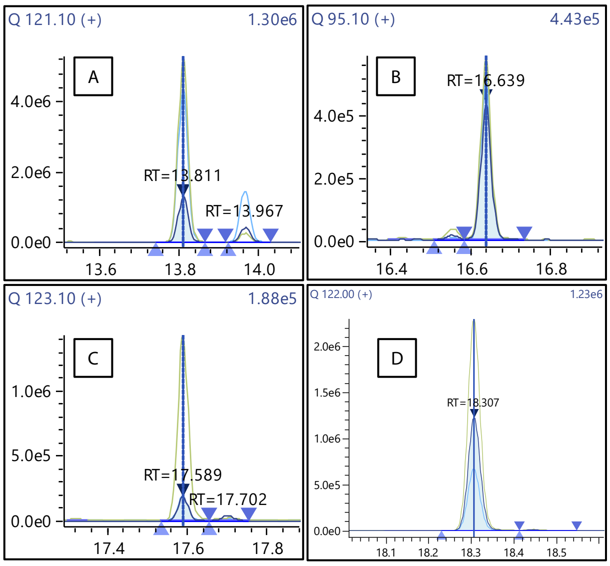

Fig. 5 Mass Chromatograms of (A) Linalool, (B) Citronellol, (C) Geraniol, and (D) 2-Phenylethanol

On-skin Fragrance Study

The on-skin fragrance study was conducted to evaluate the persistence of perfume compounds over time. Sampling was performed at three distinct time points: 15 minutes, 1 hour, and 6 hours after applying the perfume (as described in Fig. 2). Fig. 6 shows the percentage of compounds detected (out of 60 compounds) in these three different time points.

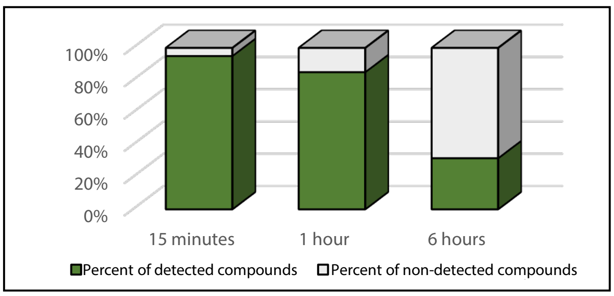

Fig. 6 Chart of the Percent Compounds Detected in 15 minutes, 1 hour, and 6 hours After Perfume Application.

The results, summarized in Table 2, reveal significant insights into the retention characteristics of the perfume compounds:

EXP 1 (15 Minutes After Applying Perfume)

At the 15-minute mark, 58 out of the 60 monitored fragrance compounds were detected. All of them had the concentrations at their highest (compared to EXP 2 and EXP 3), indicating the initial burst of fragrance immediately after application on the skin. This is consistent with the expected behavior of volatile compounds, which tend to evaporate quickly upon exposure to air.

EXP 2 (1 Hour After Applying Perfume)

After 1 hour, a noticeable decrease in both the number of compounds detected and their concentrations were observed. 52 out of the 60 fragrance compounds monitored were detected. It is worth noting that certain compounds exhibited a slower rate of decline, suggesting their role in the mid-notes of the fragrance profile. These compounds contribute to the sustained aroma that becomes more prominent as the initial top notes dissipate.

EXP 3 (6 Hours After Applying Perfume)

By the 6-hour mark, only 19 monitored compounds remained at detectable levels. The concentrations of most compounds had further decreased. These residual compounds are likely responsible for the base notes of the fragrance, providing the long-lasting scent that lingers on the skin. The persistence of these compounds highlights their importance in the overall fragrance composition and their contribution to the longevity of the perfume.

Sampling Repeatability

To assess the repeatability of the on-skin sampling method, three replicate samplings were carried out for EXP 1 at 3 different spots of the arm. The result, shown in Table 2, displays that 57 out of 58 detected fragrance compounds exhibiting a relative standard deviation (%RSD) of less than 20% for their semi-quantitated concentrations.

.Conclusion

In this study, we demonstrate the effectiveness of using GCMS-QP2050 with Smart Aroma Database and Monotrap adsorbent to analyze the behavior of perfume fragrance on human skin. The result shows decrease percentage of number of compounds detected over time. The peak area of most compounds were reduced as well. Sampling repeatability shows that 57 out of 58 detected aroma compounds exhibiting %RSD values below 20% (n=3).

Table 2 Peak Area of Each Fragrance Compounds in Perfume Sample at Different Sampling Point

ID.	Compound Name	Peak Area			%RSD Peak Area at 15 min After Applying Perfume (n=3)
		15 Mins After Applying Perfume	1 hour After Applying Perfume	6 hours After Applying Perfume	
1	beta-Pinene	3809	1882	580	15.7
2	Myrcene	71933	9083	-	2.1
3	1,4-Cineole	460	-	-	17.0
4	Limonene	40639	5472	965	7.3
5	1,8-Cineole	23615	7787	992	11.3
6	Ethyl hexanoate	-	-	-	-
7	(E)-beta-Ocimene	30397	3807	-	2.3
8	p-Cymene	5265	687	-	12.6
9	Ethyl heptanoate	6680	197	-	11.4
10	cis-Rose Oxide	38872	2316	-	8.1
11	trans-Rose Oxide	9000	618	-	8.5
12	cis-3-Hexen-1-ol	697	-	-	14.4
13	Menthone	66511	1448	-	6.6
14	(Z)-3-hexenyl butyrate	2136008	28094	-	1.9
15	(E)-Linalool oxide	166536	2830	-	1.9
16	Isomenthone	45236	-	-	3.9
17	n-Decanal	125966	-	-	5.4
18	Benzaldehyde	12347	3040	-	3.2
19	Ethyl nonanoate	5522	-	-	3.6
20	Linalool	2194075	25600	-	2.0
21	Linalyl acetate	697345	17815	-	1.6
22	Methyl decanoate	14338	-	-	3.3
23	L-Menthol	235852	25289	-	4.5
24	Ethyl decanoate	72662	19065	548	4.6
25	Citronellyl acetate	89719	15592	-	4.9
26	Dihydrocarvyl acetate	36887	2675	-	4.2
27	Neral	46197	5719	-	4.1
28	alpha-Terpinyl acetate	46346	4292	1554	4.4
29	alpha-Terpineol	413765	46791	629	6.1
30	gamma-Terpineol	654781	75852	1528	5.6
31	Neryl acetate	74308	19079	-	5.0
32	Geranial	37363	6374	-	4.2
33	d-Carvone	40626	1178	-	4.1
34	Epoxylinalool isomer-1	82372	20807	-	5.5
35	Geranyl acetate	132958	44393	-	5.2
36	Epoxylinalool isomer-2	46718	15922	-	5.8
37	Citronellol	778469	481070	-	7.2
38	Ethyl phenylacetate	42989	1292	-	3.2
39	Nerol	213476	113966	-	7.0
40	2-Phenylethyl acetate	221471	14561	-	3.5
41	Geraniol	331314	262070	-	7.2
42	Ethyl laurate	24623	24706	1118	4.6
43	Alpha-isomethylionone	282198	188735	2954	6.1
44	Benzyl alcohol	179950	19165	5295	4.5
45	Geranyl butyrate	2665	2348	-	4.6
46	2-Phenylethanol	2398685	690213	-	5.2
47	Hydroxycitronellal	2367	2899	-	5.4
48	beta-Ionone	672305	583801	6730	6.0
49	(Z)-Nerolidol	9893	11769	1774	6.3
50	Methyl myristate	785	723	-	2.7
51	4-Methoxybenzaldehyde	95995	20797	-	7.5
52	(E)-Nerolidol	10228	13266	3484	7.2
53	Lilial	17389	17530	1261	3.8
54	Ethyl myristate	2210	2586	2496	9.7
55	gamma-Decalactone	43321	45683	1587	3.2
56	Ethyl palmitate	-	-	-	-
57	trans,trans-Farnesol	533	683	1168	6.2
58	alpha-Hexylcinnamaldehyde	46831	47191	57799	8.4
59	Coumarin	14791	11944	-	11.8
60	Benzyl salicylate	619	601	662	25.5

■ References

1) Smart Aroma Database Instruction Manual.
2) GL Sciences MonoTrap SG DCC18 Catalogues.

■ Acknowledgement

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