Analysis of Floral Scent in *Cymbidium* Cultivar 'Sunny Bell' by Electronic Nose and Gas Chromatography-Mass Spectrometry

Yun Su Baek[1]*, Pue Hee Park[1], Su Yeoung Kim[1], Hye Ryun An[1], Pil Man Park[1], Oung Chio[1], Oh Keun Kwon[1], and In Chang Son[2]

[1]Floriculture Research Division, National Institute of Horticultural & Herbal Science, Rural Development Administration, Wanju 55365, Korea

[2]Research Institute of Climate Change and Agriculture, National Institute of Horticultural & Herbal Science, Rural Development Administration, Jeju 63240, Korea

Abstract

Cymbidium is the most important crop in the Orchidaceae family. There are several beautiful and colorful *Cymbidium* species flowers. Among them a few species of *Cymbidium* have a floral scent and flavor. Headspace-solid phase microextraction-gas chromatography-mass spectrometry (HS-SPME-GC-MS) was used to identify the floral scent of the different floral organs of *Cymbidium* cultivar 'Sunnybell' for the evaluation of floral volatile polymorphism as a basis to determine the best time of harvest. Electronic nose analysis results, coupled with discriminant factor analysis, suggested that emitted odors varied in different *Cymbidium* cultivar 'Sunnybell' floral organs, including the column, labellum, sepals, and petals. The first two discriminant factors explained 99.193 % of total system variance. The major floral scent were α-pinene, β-myrcene, 2,6-dimethlnonane, eucalyptol, trans-b-ocimene, 4,8-dimethyl-1,3,7-nonatriene, and linalool,. Moreover, in a principal component analysis, sepals and petals were located closely on the score plot.

Introduction

Sunny Bell (サニーベル)

- Purple flower color
- Interspecific hybrid (small plant type)
- Early and Middle winter flowering (from early Decenber)

Method

➢ Electronic-nose (E-nose) system

- Analysis System - Sensor array system aFox 2000 6 chennel (Alpha MOS, France)
- Head space system accessories procedures were performed with PAL SyrHS 5.0 mL (Kit HS Syringe 5.0 mL of CombiPAL)
- Data analysis - discriminant function analysis (DFA)

➢ HS-SPME-GC-MS system

- Analysis System - 7000c triple quadrupole GC/MS (Agilent, USA)
- SPME system - Gerstels multipurpose Sampler (MPS)
- HS-SPME procedures were performed with Supelco SPME fiber, coated with polydimethylsiloxane (DVB/CAR/PDMS, 50/30 mm).

➢ Analytical conditions with the HS-SPME-GC-MS system

sample	Cymbidium cultivar 'Sunny Bell'
fiber	50/30 μm DVB/CAR/PDMS
equilibrate time	60 min
equilibrate temperature	25 ℃
system	7000c triple quadrupole GC/MS (Agilent, USA)
column	DB-5MS column (30 m × 0.25 mm I.D. × 0.25 μm microns, Agilent Technologies)
carrier gas (He)	1ml/min
oven temperature	60 ~ 250 ℃, 3 ℃/min
injecter temperature	250 ℃
injection type	splitless
EI-MS electron energy	70 eV
Ion source and connection parts temperature	250 ℃

Results

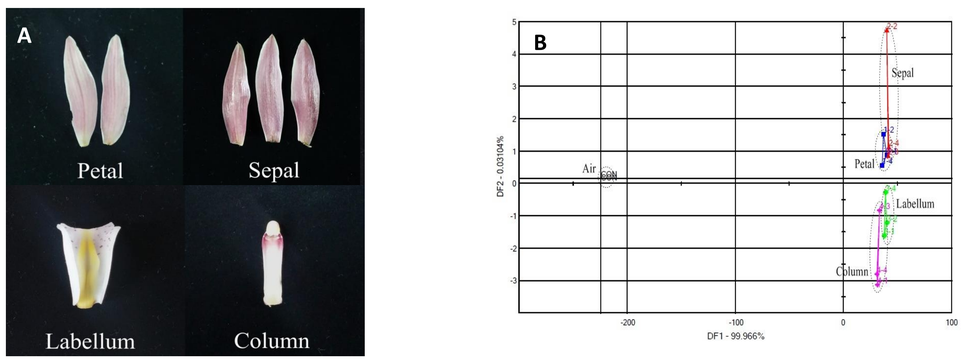

Fig. 1. Floral organs and discriminant function analysis (DFA) plot of fragrant patterns in *Cymbidium* cultivar 'Sunny Bell' using electronic nose.(A: floral organs, B: fragrant patterns)

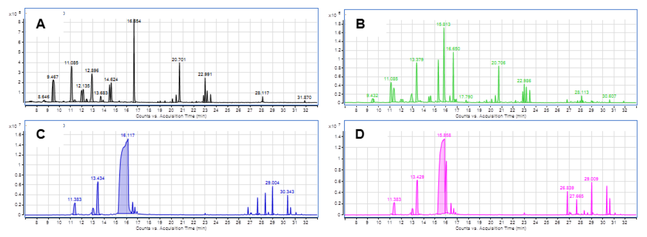

Fig. 2. Total ion chromatograms of column (A), labellum (B), sepals (C), and petals (D) obtained by SPME of the Cymbidium cultivar 'Sunny Bell' analyzed.

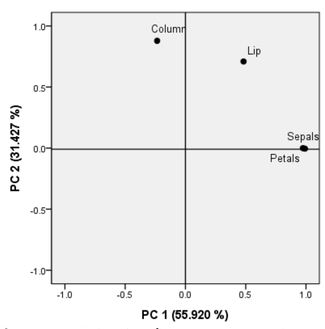

Fig. 3. Principal components analysis (PCA) plots of flower from different parts of Cymbidium cultivar 'Sunny Bell' flower by HS-SPME-GC-MS.

Table 1. Percentages of floral scent in different parts of *Cymbidium* cultivar 'Sunny Bell'.

Peak	RI[a]	Compounds	Relative Content (%) ± SD			
			Column	Labellum	Sepal	Petal
1	934	α-pinene	27.41 ± 2.52	5.27 ± 1.59		3.12 ± 0.14
2	990	β-myrcene	0.94 ± 0.22	8.62 ± 0.31	3.50 ± 0.06	
3	1007	2,6-dimethylnonane	16.21 ± 1.20	2.89 ± 0.12		
4	1032	eucalytol	16.40 ± 1.77	6.90 ± 0.96		
5	1035	cis-β-ocimene			1.65 ± 0.07	1.55 ± 0.15
6	1047	trans-β-ocimene		13.94 ± 0.81	8.03 ± 0.10	7.13 ± 0.27
7	1076	cis-1,1,3,4-tetramethylcyclopentane	6.75 ± 0.16	1.93 ± 0.08		
8	1080	2,4-dimethyl-1-decene	8.18 ± 0.24	2.43 ± 0.23		
9	1113	4,8-dimethyl-1,3,7-nonatriene		18.77 ± 1.06	5.67 ± 4.58	
10	1121	linalool		13.61 ± 3.30	69.68 ± 5.26	80.37 ± 0.68
11	1128	allocimene A		1.72 ± 0.07	1.35 ± 0.33	
12	1133	3-isopropylidene-5-methyl-1,4-hexadiene				1.33 ± 0.09
13	1229	2,6-dimethylnonane	0.83 ± 0.17	2.37 ± 0.06		
14	1237	4,6-dimethyldodecane	1.71 ± 0.38			
15	1245	1,3-di-tert-butylbenzene	10.51 ± 2.07	9.74 ± 0.11		
16	1300	2-isopropyl-5-methyl-1-heptanol	1.48 ± 0.45	2.25 ± 0.08		
17	1309	7-methyl-1-undecene	2.52 ± 0.92	3.69 ± 0.07		
18	1318	hexyl octyl ether	1.65 ± 0.61	2.49 ± 0.10		
19	1422	caryophyllene		0.61 ± 0.07	1.56 ± 0.68	
20	1454	β-farnesene			1.07 ± 0.15	1.03 ± 0.19
21	1480	β-ionone				1.56 ± 0.14
22	1504	α-farnesene			2.93 ± 0.10	2.49 ± 0.34
23	1562	(±)-trans-nerolidol			2.25 ± 0.28	1.52 ± 0.20
24	1574	(3E,7E)-4,8,12-Trimethyl-1,3,7,11-tridecatetraene			1.13 ± 0.10	

[a] Retention indices, using *n*-alkane (C_8-C_{17}) as reference.

Discussion

The order of stronger scent was as follows: **sepals** > **petals** > **labellum**> **column** in floral organs. The main components were represented by α-pinene, β-myrcene, 2,6-dimethylnonane, eucalyptol, trans-β-ocimene, 4,8-dimethyl-1,3,7-nonatriene, and linalool.

Reference

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