



Micromorphological Features, DNA Barcoding and Nutraceutical Compounds of Two Edible Flowers: *Petunia × Hybrida* and *Verbena Bonariensis*



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Table 1. The scientific name, family, origin, blooming period, synthetic description, and flower photos of *P. × hybrida* and *V. bonariensis*.

Scientific Name	Origin	Blooming Period	Synthetic Botanical Description	Photo of Flower
<i>Petunia × hybrida</i> Vilm. (Solanaceae)	South America	April - October	Annual herbs, either ascending or decumbent, reaching heights of 30-60 cm. Leaves are alternate, shortly petiolate or subsessile, ovate in shape measuring 3-8 x 1.5-4.5 cm, with a cuneate base, entire margin, and acute apex. Flowers are solitary, found in the axils of leaves or leaf-like bracts, with a calyx deeply divided into 5 parts (1-1.8 cm by 3.5 mm). The corolla is funnellform with 5 rounded, spreading lobes (5-7 cm) and can be fragrant. There are 5 stamens (1 short, 2 medium and 2 long), with a style slightly exceeding stamens. Capsules are conical, 2-valved, 8-12 mm long, and dehiscent, containing many subglobose seeds approximately 0.5 mm across. The aerial part feature soft glandular hairs are present on. Lifeform: Scapular Ther. (Lim, 2014)	


Scientific Name	Origin	Blooming Period	Synthetic Botanical Description	Photo of Flower
<i>Verbena bonariensis</i> L. (Verbenaceae)	South America	April - October	Perennial erect herbs with quadrangular stem 80-150 cm tall. Leaves are opposite, persistent, hirsute, and oblong-lanceolate, clasping and auriculate at the base, measuring 5-11 cm x 10-20 mm. They have adaxially impressed vein, sharply serrate and narrowly revolute margins, and no petioles. Spikes form compound cymes, (corymbs) with compact, dense, and thick clusters. Bracts are narrowly triangular to lanceolate 2.1-2.8 mm. Calyces 3-3.5 mm purplish, hirsutulous, and stipitate-glandular. Corollas are purple to blue-violet or pinkish, with a tube 4-6 mm long, 1.5-2 mm longer than calyces, and limbs 2-5 mm in diameter. Small fruits separate into four brown seeds, which are elongated in shape 1.5-1.9 mm long. Lifeform: Scapular Hemicr. (Nesom, 2010)	

Table 2. Volatile emission analysis using HS-SPME-GC-MS method for *Petunia × hybrida* and *V. bonariensis*.

No	Compounds	Formula	Class	LRI ^{cal}	LRI ^{lit}	<i>P × hybrida</i>	<i>V. bonariensis</i>
						Relative Abundance (%)	
1	Oxime., methoxy-phenyl ^{bnzo}	C ₈ H ₉ NO ₂	NC	898	899*	2.0±0.63	0.6±0.03
2	Benzaldehyde ^{bnzo}	C ₇ H ₆ O	ALD	962	961f	-	6.7±0.25
3	5-Hepten-2-one, 6-methyl ^{ali}	C ₈ H ₁₄ O	KET	986	987\$	0.3±0.07	-
4	Benzyl alcohol ^{bnzo}	C ₇ H ₈ O	ALC	1036	1033f	-	0.3±0.02
5	(Z)- α -Ocimene	C ₁₀ H ₁₆	MH	1038	1041\$	-	0.2±0.03
6	(E)- α -Ocimene	C ₁₀ H ₁₆	MH	1049	1051\$	-	47.6±2.02
7	Benzoic acid, methyl ester (methyl benzoate) ^{bnzo}	C ₉ H ₈ O ₂	EST	1094	1091f	12.7±0.31	1.5±0.22
8	Nonanal ^{ali}	C ₉ H ₁₈ O	ADH	1104	1101f	3.7±0.10	1.3±0.23
9	Methyl salicylate ^{bnzo}	C ₉ H ₈ O ₃	EST	1192	1190f	3.2±0.33	16.1±1.54
10	2-Methoxy-5-methylphenol ^{bnzo}	C ₈ H ₁₀ O ₂	VP	1193	1201f	1.0±0.16	-
11	Decanal ^{ali}	C ₁₀ H ₂₀ O	ADH	1206	1208\$	4.9±0.17	2.3±0.19
12	3,5-Dimethyl-2-isobutylpyrazine ^{bnzo}	C ₁₀ H ₁₆ N ₂	NC	1210	1211f	1.4±0.26	0.7±0.17
13	2-phenoxy-Ethanol ^{bnzo}	C ₈ H ₁₀ O ₂	ETR	1226	1221f	0.2±0.09	-
14	<i>n</i> -Decanoic acid ^{ali}	C ₁₀ H ₂₀ O ₂	FA	1373	1380f	0.6±0.03	-
15	<i>cis</i> -isoEugenol ^{bnzo}	C ₁₀ H ₁₂ O ₂	PP	1408	1407f	4.7±0.26	-
16	<i>cis</i> - β -Bergamotene	C ₁₅ H ₂₄	SH	1415	1414f	-	1.6±0.23
17	β -Caryophyllene	C ₁₅ H ₂₄	SH	1419	1420f	0.6±0.07	13.0±1.25
19	α -Barbatene	C ₁₅ H ₂₄	SH	1436	1433\$	-	3.0±0.22
18	<i>p</i> -Mentha-1,8-dien-7-yl acetate	C ₁₂ H ₁₈ O ₂	OM	1436	1436f	0.3±0.12	-
20	<i>cis</i> -Geranylacetone	C ₁₃ H ₂₂ O	OM	1453	1457f	1.4±0.08	0.7±0.07
21	α -Humulene	C ₁₅ H ₂₄	SH	1455	1456f	-	0.9±0.09
22	<i>trans</i> - β -Bisabolene	C ₁₅ H ₂₄	SH	1533	1531f	-	0.7±0.11
23	1,2-diphenyl Ethanol ^{bnzo}	C ₁₄ H ₁₂ O	KET	1537	1537f	-	1.0±0.06
24	Hedione ^{ali}	C ₁₃ H ₂₂ O ₃	EST	1649	1648f	1.1±0.27	-
25	Elemol acetate	C ₁₇ H ₂₆ O ₂	OS	1679	1679*	1.4±0.49	-
26	Methyl (<i>E,E</i>)-farnesoate	C ₁₆ H ₂₆ O ₂	OS	1786	1785\$	-	0.5±0.01
27	isopropyl myristate ^{ali}	C ₁₇ H ₃₄ O ₂	EST	1827	1824f	2.1±0.75	-
28	Hexadecanoic acid, 3,5,5-trimethyl-, nonyl ester	C ₁₈ H ₃₆ O ₂	EST	1835	1835f	1.7±0.33	-
29	3-Ureidopropionic acid, N-dimethylaminomethylene-, methyl ester	C ₈ H ₁₅ N ₃ O ₃	EST	1847	1847\$	0.5±0.20	-
30	5,9,13-trimethyl-4,8,12-Tetradecatrienal ^{ali}	C ₁₇ H ₂₈ O	ALD	1933	1933f	3.5±0.03	-
31	Decyl octanoate ^{ali}	C ₁₈ H ₃₆ O ₂	EST	1959	1959\$	-	0.4±0.00
32	<i>n</i> -Hexadecanoic acid ^{ali}	C ₁₆ H ₃₂ O ₂	FA	1968	1965f	3.1±0.53	-
33	10-Heneicosene ^{ali}	C ₂₁ H ₄₂	ALK	2060	2060f	2.2±0.12	-
34	Dodecyl octanoate ^{ali}	C ₂₀ H ₄₀ O ₂	EST	2160	2160f	7.4±0.60	-
35	Octadecanoic acid (Stearic acid) ^{ali}	C ₁₈ H ₃₆ O ₂	FA	2172	2177f	6.1±0.25	-
36	<i>trans</i> -Geranylgeraniol	C ₂₀ H ₃₄ O	OD	2201	2201f	1.0±0.36	-

No	Compounds	Formula	Class	LRI ^{cal}	LRI ^{lit}	<i>P. x hybrida</i>	<i>V. bonariensis</i>
						Relative Abundance (%)	
37	Methyl nonadecanoate ^{al}	C ₂₀ H ₄₀ O ₂	EST	2228	2226f	21.7±1.83	-
38	Undec-10-ynoic acid, undecyl ester ^{al}	C ₂₂ H ₄₀ O ₂	EST	2308	2308f	3.0±0.46	-
39	Eicosanoic acid (=Arachidic acid) ^{al}	C ₂₀ H ₄₀ O ₂	FA	2362	2365f	0.4±0.33	-
40	Dodecyl decanoate= Lauryl caprate ^{al}	C ₂₂ H ₄₄ O ₂	EST	2373	2372f	2.8±0.22	-
41	Octanoic acid, tetradecyl ester (Myristyl caprylate) ^{al}	C ₂₂ H ₄₄ O ₂	EST	2377	2377\$	3.2±0.26	-
-	Number of Identified Compounds	-	-	-	-	30	19
-	Class of Compounds	-	-	-	-	<i>P. hybrida</i>	<i>V. bonairis</i>
-	Monoterpene Hydrocarbons (MH)	-	-	-	-	-	47.8±1.79
-	Oxygenated Monoterpenes (OM)	-	-	-	-	1.7±0.12	-
-	Sesquiterpene Hydrocarbons (SH)	-	-	-	-	0.6±0.07	19.2±1.02
-	Oxygenated Sesquiterpenes (OS)	-	-	-	-	1.4±0.49	0.5±0.01
-	Oxygenated Diterpenes (OD)	-	-	-	-	1.0±0.36	-
-	Phenylpropanoids (PP)	-	-	-	-	2.5±0.33	-
-	Volatile Phenols (VP)	-	-	-	-	1.0±0.16	-
-	Aldehydes (ADH)	-	-	-	-	12.1±0.2	10.3±0.21
-	Alcohol (ALC)	-	-	-	-	-	0.3±0.02
-	Alkanes (ALK)	-	-	-	-	2.2±0.12	-
-	Esters (EST)	-	-	-	-	61.6±0.70	18.0±0.71
-	Ethers (ETR)	-	-	-	-	0.2±0.09	-
-	Fatty Acid (FA)	-	-	-	-	10.2±0.20	-
-	Ketones (KET)	-	-	-	-	0.3±0.07	1.7±0.06
-	Nitrogenous Compounds (NC)	-	-	-	-	3.4±0.43	1.3±0.13
-	Total identified	-	-	-	-	98.2±2.50	99.1±0.35

Note: Compound^{benzo}: Benzoid compounds; Compound^{al}: Aliphatic compound; LRI^{cal}: Linear retention index calculated; LRI^{lit}: Linear retention index reported in literature; f: pubchem.ncbi.nlm.nih.gov; \$: webbook.nist.gov; *: pherobase.com (all web site visited in the date of 14-01.2024).