

Exploring the Antimicrobial Properties of 99 Natural Flavor and Fragrance Raw Materials Against Pathogenic Bacteria: A Comparative Study with Antibiotics

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Table S1. Minimal Inhibitory Concentration (MIC) parameters of natural flavour and fragrance materials on all evaluated strains.

No.	English common name of natural fragrance material	Company	CAS number	Botanical name	Origin	Gram-positive bacteria				Gram-negative bacteria					
						<i>S. aureus</i>	<i>K. rhizophila</i>	<i>S. epidermidis</i>	<i>C. acnes</i>	<i>P. gergoviae</i>	<i>P. fluorescens</i>	<i>P. putida</i>	<i>B. cepacia</i>	<i>K. aerogenes</i>	<i>K. pneumoniae</i>
						MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]	MIC assay [µg/ml]
Achariaceae															
1.	Styrax gum	Berje Inc.	8046-19-3	<i>Liquidambar styraciflua</i> L.	Honduras	>400	>400	800	>400	>400	>400	>400	>400	>400	>400
Acoraceae															
2.	Calamus EO	Berje Inc.	8015-79-0	<i>Acorus calamus</i> L.	Nepal	400	800	>400	800	>400	200	>400	>400	800	>400
Ammonaceae															
3.	Ylang-Ylang I EO	Lluch Essence	8006-81-3	<i>Cananga odorata</i> Hook. f. & Thomson forma <i>genuina</i>	Comoros	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
4.	Ylang-Ylang I EO	Lebermuth	8006-81-3		Madagascar	800	>400	>400	>400	>400	>400	>400	>400	>400	>400
5.	Ylang-Ylang II EO	Lebermuth	8006-81-3		Madagascar	800	>400	>400	>400	>400	>400	>400	>400	>400	>400
6.	Ylang-Ylang III EO	Lluch Essence	8006-81-3		Comoros	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
Apiaceae															
7.	Angelica root Oil	Ultra International	8015-64-3	<i>Angelica archangelica</i> L.	France	400	>400	>400	800	>400	>400	>400	>400	800	>400
8.	Angelica root EO	Berje Inc.	8015-64-3		Hungary	>400	400	>400	25	>400	200	200	800	800	>400
9.	Angelica seed EO	Berje Inc.	8015-64-3		USA	>400	400	>400	800	>400	200	200	400	>400	>400
Apiaceae															
10.	Coriander herb EO	Ultra International	8008-52-4	<i>Coriandrum sativum</i> L.	Russia	>400	25	50	800	200	200	200	50	25	50
11.	Dill seed EO	Berje Inc.	8006-75-5	<i>Anethum graveolens</i> L.	South Africa	200	>400	>400	>400	>400	>400	>400	>400	>400	>400
12.	Lovage leaf EO	Berje Inc.	8016-31-7	<i>Levisticum officinale</i> W.D.J. Koch	Hungary	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
13.	Lovage root EO	Berje Inc.	8016-31-7		Hungary	200	800	>400	>400	>400	400	800	>400	>400	>400
14.	Parsley leaf EO	Berje Inc.	8000-68-8	<i>Petroselinum crispum</i> (Mill.) Fuss syn. <i>Petroselinum sativum</i> Hoffm	Australia	400	800	>400	>400	>400	200	400	800	>400	>400
Asteraceae															
15.	Artichoke absolute	A. Fakhry & Co.	93165-00-5	<i>Cynara cardunculus</i> L.	Egypt	>400	>400	>400	800	>400	>400	400	800	100	>400
16.	Goldenrod EO	Lebermuth	96690-40-3	<i>Solidago canadensis</i> L.	Canada	>400	>400	>400	>400	>400	>400	400	>400	>400	>400
17.	Milfoil EO	Berje Inc.	8022-07-9	<i>Achillea millefolium</i> L.	Spain	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
18.	Mugwort EO	Ultra International	8008-93-3	<i>Artemisia taurica</i> Willd.	Russia	>400	100	>400	>400	>400	>400	>400	>400	>400	>400
19.	Tagete EO	A. Fakhry & Co.	8016-84-0	<i>Tagetes minuta</i> L. syn. <i>Tagetes glandulifera</i> Schrank	Egypt	>400	>400	>400	>400	>400	200	>400	>400	>400	>400
20.	Tagete EO	Berje Inc.	8016-84-0		Zimbabwe	400	>400	800	>400	>400	200	400	>400	>400	>400
21.	Wormwood herb EO	Berje Inc.	8008-93-3	<i>Artemisia absinthium</i> L.	Russia	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
22.	Wormwood herb EO	Berje Inc.	8008-93-3	<i>Artemisia absinthium</i> L.	USA	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
Cistaceae															
23.	Cistus SEV absolute	Albert Vieille	8016-26-0	<i>Cistus ladanifer</i> L.	Spain	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
24.	Labdanum gum refined	Berje Inc.	8016-26-0		Spain	>400	200	100	800	800	200	200	200	100	400
Cupressaceae															
25.	Blue cypress EO	Ultra International	187348-13-6	<i>Callitris intratropica</i> Baker & H.G.Sm.	Australia	50	50	50	400	200	100	25	25	50	100
26.	Hinoki EO	Ultra International	91745-97-0	<i>Chamaecyparis obtusa</i> (Siebold & Zucc.) Endl.	Japan	100	200	400	800	>400	200	100	200	400	>400
27.	Juniper berry CO ₂	Ultra International	8012-91-7	<i>Juniperus communis</i> L.	India	200	25	25	800	50	50	100	50	25	100
28.	Siam wood EO	Berje Inc.	8022-47-7	<i>Fokienia hodginsii</i> (Dunn) A.Henry & H H.Thomas	Vietnam	>800	800	800	800	>400	>400	400	800	800	800
Dipterocarpaceae															
29.	Gurjun Balsam rectified (Copaene)	Lluch Essence	8030-55-5	<i>Dipterocarpus</i> C. F. Gaertner	Indonesia	>400	>400	>400	>400	>400	>400	400	>400	>400	>400
Euphorbiaceae															
30.	Cascarilla bark EO	Berje Inc.	28231-03-0	<i>Croton eluteria</i> (L.) W. Wright syn. <i>Clutia eluterzia</i> L.	El Salvador	>400	200	200	800	>400	>400	200	400	400	>400
Fabaceae															
31.	Copaiba Balsam	Lluch Essence	8001-61-4	<i>Copaifera officinalis</i> L.	Brazil	100	25	200	>400	800	>400	400	200	800	>400
32.	Peru balsam resin	Lebermuth	8007-00-9	<i>Myroxylon peruiferum</i> L.f.	Peru	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
Geraniaceae															
33.	Rose geranium EO	Eucaforest	90082-55-6	<i>Pelargonium graveolens</i> L'Hér.	South Africa	>400	>400	>400	>400	>400	400	800	>400	>400	>400
Iridaceae															
34.	Orris root concentrate	Berje Inc.	8002-73-1	<i>Iris pallida</i> Lam.	France	100	400	400	800	800	>400	>400	800	400	800
Lamiaceae															

35.	Basil oleoresin	Lluch Essence	8015-73-4	Ocimum basilicum L.	India	800	800	>400	>400	>400	>400	800	800	800	>400	
36.	Basil sweet CT (linalool) EO	Vessel Essential Oils	8015-73-4		Greece	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
37.	Basil tropical CT (methylchavicol) EO	A. Fakhry & Co.	8015-73-4		Egypt	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
38.	Catnip (catmint) EO	Berje Inc.	8023-84-5	Nepeta cataria L.	Canada	>400	800	>400	100	>400	200	400	>400	>400	>400	
39.	Lavandin abrialis EO	Berje Inc.	8022-15-9	Lavandula angustifolia Mill. × Lavandula latifolia Medik.	France	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
40.	Origanum oleoresin	Lluch Essence	8007-11-2	Origanum vulgare L.	Turkey	400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
41.	Peppermint Yakima EO	Berje Inc.	8006-90-4	Mentha x piperita L.	USA	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
42.	Peppermint tails EO	Lebermuth	N/A		Italy	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
43.	Perilla EO	Berje Inc.	68132-21-8	Perilla frutescens (L.) Britton	China	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
44.	Savory summer EO	Berje Inc.	8016-68-0	Satureja hortensis L.	Hungary	>400	800	>400	>400	>400	400	800	800	>400	>400	
45.	Thyme red oleoresin	Lluch Essence	8007-46-3	Thymus vulgaris L.	Turkey	400	>400	>400	>400	>400	>400	400	>400	>400	>400	
Lauraceae																
46.	Laurel Oleoresin	Lluch Essence	8007-48-5	Laurus nobilis L.	Spain	400	800	>400	800	>400	>400	800	800	800	800	
47.	Ocotea cymbarum EO	Berje Inc.	68917-09-9	Ocotea cymbarum Kunth	China	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
48.	Ravintsara EO	Lluch Essence	92201-50-8	Cinnamomum camphora Ness et Eberm.	Madagascar	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
49.	Rosewood (Bois de rose) EO	Berje Inc.	8015-77-8	Aniba rosodora Ducke	India	>400	>400	>400	>400	>400	200	>400	>400	>400	>400	
50.	Sassafras EO	Berje Inc.	8006-80-2	Sassafras albidum (Nutt.) Nees	Taiwan	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
Meliaceae																
51.	Neem oil (exp.)	Lebermuth	8002-65-1	Azadirachta indica A. Juss.	India	800	>400	>400	>400	>400	>400	>400	>400	>400	>400	
Myrtaceae																
52.	Blue mallee EO	Lebermuth	91771-67-4	Eucalyptus polybractea R. T. Baker	Australia	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
53.	Eucalyptus kochii EO	Ultra International	97926-42-6	Eucalyptus kochii Maiden & Blakely	Australia	>400	>400	>400	>400	>400	200	>400	>400	>400	>400	
54.	Eucalyptus smithii EO	Eucaforest	91771-68-5	Eucalyptus smithii R. T. Baker	South Africa	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
55.	Kunzea EO	Ultra International	97553-36-1	Kunzea ambigua (Sm.) Druce	Australia	>400	>400	>400	>400	>400	>400	400	>400	>400	>400	
56.	Lemon Myrtle EO	Ultra International	84775-80-4	Backhousia citriodora F. Muell.	Australia	400	>400	>400	>400	>400	400	800	>400	>400	>400	
57.	Lemon scented tea tree EO	Eucaforest	85085-43-4	Leptospermum petersonii F. M. Bailey syn. Leptospermum citratum Challinor, Cheel & Penfold	South Africa	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
58.	Rosalina EO	Ultra International	68647-73-4	Melaleuca ericifolia Sm.	Australia	>400	200	>400	800	>400	200	200	200	>400	>400	
59.	Tea tree EO	Lebermuth	68647-73-4	Melaleuca alternifolia (Maiden & Betche) Cheel	China	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
60.	Tea tree EO	Eucaforest	68647-73-4		South Africa	>400	>400	>400	>400	>400	>400	200	200	>400	>400	>400
Pinaceae																
61.	Cedarwood Himalayan EO	Lebermuth	68991-36-6	Cedrus deodora (Roxb. ex Lamb.) G.Don	India	>400	>400	>400	>400	>400	>400	400	>400	>400	>400	
62.	Fir needle EO	Berje Inc.	8024-15-5		Abies balsamea (L.) Mill.	Canada	400	>400	>400	>400	>400	200	200	>400	>400	>400
63.	Fir balsam absolute	Berje Inc.	8024-15-5			Canada	200	12.5	50	25	100	50	12.5	50	25	100
64.	Fir balsam concrete	Berje Inc.	8024-15-5			Canada	400	200	100	100	>400	>400	50	100	200	400
65.	Pine pumilio EO	Berje Inc.	616-768-0	Pinus pumilio Turra	Germany	>400	>400	>400	>400	>400	200	800	>400	>400	>400	
66.	Spruce absolute	Berje Inc.	294-420-3	Picea glauca/Picea mariana (Mill.) Britton, Sterns & Poggenb.	Canada	>400	800	800	>400	>400	>400	400	800	800	800	
67.	Spruce black EO	Lebermuth	91722-19-9	Picea mariana (Mill.) Britton, Sterns & Poggenb.	Canada	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400	
Piperaceae																
68.	Cubeb EO	Berje Inc.	290-148-4	Piper cubeba L.	Singapore	>400	200	200	25	>400	>400	12.5	200	200	>400	
69.	Black pepper oleoresin 40/20	Lluch Essence	8002-56-0	Piper nigrum L.	India	100	800	800	800	>400	>400	400	800	>400	>400	
Poaceae																
70.	Vetiver CO ₂	Ultra International	8016-96-4	Chrysopogon zizanioides (L.) Roberty syn. Vetiveria zizanioides (L.) Nash	India	>400	200	100	800	200	200	100	100	400	200	
Ranunculaceae																
71.	Black seed expressed EO	Ultra International	90064-32-7	Nigella sativa L.	India	25	800	>400	800	200	200	>400	>400	200	200	
Rosaceae																
72.	Rose absolute	Ultra International	8007-01-0	Rosa x damascena Mill.	Bulgaria	400	>400	>400	>400	>400	400	>400	>400	>400	>400	
73.	Rose absolute	Ultra International	8007-01-0		Morocco	>400	>400	>400	>400	>400	400	>400	>400	>400	>400	
74.	Rose EO	Ultra International	8007-01-0		Bulgaria	800	>400	>400	>400	>400	>400	>400	>400	>400	>400	
75.	Rose EO	Ultra International	8007-01-0		Turkey	>800	>400	>400	>400	>400	>400	400	>400	>400	>400	

Rubiaceae															
76.	Coffee Arabica CO ₂	Ultra International	8001-67-0	<i>Coffea arabica</i> L.	India	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
77.	Coffee Robusta CO ₂	Ultra International	8001-67-0	<i>Coffea canephora</i> Pierre ex Froehner	India	>400	>400	800	>400	>400	200	>400	>400	>400	>400
78.	Coffee EO	Berje Inc.	8001-67-0	<i>Coffea arabica</i> L.	El Salvador	200	>400	800	800	>400	100	200	>400	>400	>400
Rutaceae															
79.	Buchu leaf EO	Berje Inc.	68650-46-4	<i>Agathosma betulina</i> (P.J. Bergius) Pillans	South Africa	>400	>400	>400	>400	>400	200	400	>400	>400	>400
80.	Buchu leaf EO	Berje Inc.	68650-46-4	<i>Agathosma crenulate</i> L.	South Africa	>400	>400	>400	>400	>400	200	400	>400	>400	>400
81.	Buchu leaf EO	Ultra International	68650-46-4	<i>Agathosma betulina</i> Berg.	South Africa	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
82.	Grapefruit red EO	Lebermuth	8016-20-4	<i>Citrus x paradisi</i> Macfad.	USA	400	>400	>400	>400	>400	>400	>400	>400	>400	>400
83.	Kumquat EO	Ultra International	N/A	<i>Fortunella japonica</i> Swingle	Brazil	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
84.	Mandarin red EO	Berje Inc.	8008-31-9	<i>Citrus reticulata</i> Blanco syn. <i>Citrus nobilis</i> Andrews	Argentina	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
85.	Orange bitter (fruit), distilled EO	A. Fakhry & Co.	68916-04-1	<i>Citrus x aurantium</i> L. var. <i>amara</i>	Egypt	800	>400	>400	>400	>400	>400	400	>400	>400	>400
86.	Orange blood EO	Ultra International	8008-57-9	<i>Citrus sinensis</i> (L.) Osbeck	Italy	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
Santalaceae															
87.	Australian sandalwood EO	Dutjahn Sandalwoods Oils	8024-35-9	<i>Santalum spicatum</i> (R.Br.) A. DC syn. <i>Eucarya spicata</i> (R.Br.) Sprag et Summ.	Australia	>400	400	100	400	800	>400	200	400	800	>400
Schisandraceae															
88.	Star anise, type CO ₂	Ultra International	84650-59-9	<i>Illicium verum</i> Hook. f.	India	>400	>400	>400	800	>400	>400	400	>400	>400	>400
89.	Anise EO	Berje Inc.	283-518-1	<i>Illicium verum</i> Hook. f.	China	400	>400	>400	>400	>400	200	400	>400	>400	>400
Scrophulariaceae															
90.	Buddawood EO	Ultra International	1429902-59-9	<i>Eremophila mitchellii</i> Benth.	Australia	>400	800	800	>400	>400	>400	400	800	800	>400
Solanaceae															
91.	Capsicum oleoresin 1.000.000 SHU	Lluch Essence	8023-77-6	<i>Capsicum annuum</i> var. <i>annuum</i> L.	India	400	>400	>400	>400	>400	>400	>400	>400	>400	>400
92.	Paprika Oleoresin 40.000 CU	Lluch Essence	84625-29-6		India	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
93.	Paprika Oleoresin 80.000 CU	Lluch Essence	84625-29-6		India	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
Valerianaceae															
94.	Valerian EO	Berje Inc.	616-930-0	<i>Valeriana officinalis</i> L.	China	>400	>400	>400	>400	>400	400	>400	>400	>400	>400
Verbenaceae															
95.	Verbena EO	Lluch Essence	8024-12-2	<i>Lippia citriodora</i> Kunth.	Morocco	>400	>400	>400	>400	>400	>400	200	>400	>400	>400
Vitaceae															
96.	Cognac white EO	Berje Inc.	232-403-4	<i>Vitis vinifera</i> L.	USA	100	800	>400	800	>400	100	200	>400	800	>400
Zingiberaceae															
97.	Cardamom green CO ₂	Ultra International	8000-66-6	<i>Elettaria cardamomum</i> (L.) Maton	India	400	800	>400	>400	>400	>400	400	800	800	>400
98.	Ginger EO	Ultra International	8007-08-7	<i>Zingiber officinale</i> Roscoe	India	>400	200	100	400	>400	100	>400	800	800	>400
99.	Turmeric CO ₂	Ultra International	8024-37-1	<i>Curcuma longa</i> L.	India	>400	>400	>400	>400	>400	>400	>400	>400	>400	>400
Antibiotics [µg/ml]															
	Gentamicin					5.000	1.000				2.000	0.625			
	Ciprofloxacin						0.625				0.008	0.019	0.250	0.019	0.500
	Ampicillin							0.0625	0.250	0.008					