

APPENDIX A

Trail pheromone composition in ants

The following table presents a review of the currently identified trail pheromone in ants (see [Morgan \(2009\)](#) and [El-Sayed \(2008\)](#) for more details). For each described species, the compounds known to be involved in the trail pheromone are listed and the authorities cited. Some complementary information about the chemical compounds are provided such as the functional group, the chain length and the molecular weight.

Trail pheromone composition						
GENUS	SPECIES	CHEMICAL COMPOUNDS	FUNCTIONAL GROUP	CHAIN LENGTH	MOLECULAR WEIGHT	REFERENCES
Myrmicinae						
Dacetini						
Daceton	Daceton armigerum	2,5-Dimethylpyrazine	Amine	C03	108,14	(Morgan et al., 1992)
		2,3,5-Trimethylpyrazine	Amine	C04	122,17	
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		9-Tricosene	Hydrocarbon	C23	324,63	
		Tricosane	Hydrocarbon	C23	324,63	
		9-Pentacosene	Hydrocarbon	C25	350,66	
Solenopsidini						
Monomorium	Monomorium pharaonis	3-Butyl-5-methyloctahydroindolizine	Amine	C13	195,34	(Edwards and Chambers, 1984; Ritter et al., 1977)
		monomorine I	Amine	C13	195,34	
		monomorine III	Amine	C15	223,4	
		faranal	carboxylic acid	C13	250,42	
		monomorine V	Amine	C14	267,49	
		monomorine I	Amine	C13	195,34	
		monomorine II	Amine	C13	197,36	
		monomorine III	Amine	C15	223,4	
		monomorine IV	Amine	C14	239,44	
		Z,E-alpha-farnesene	Hydrocarbon	C12	204,35	
Solenopsis	Solenopsis invicta	E,E-alpha-farnesene	Hydrocarbon	C12	204,35	(Williams et al. 1981; Van der Meer et al. 1981, Van der Meer 1983; Van der Meer et al. 1988)
		Z,E-alpha-homofarnesene	Hydrocarbon	C12	218,38	
		Z,Z-alpha-homofarnesene	Hydrocarbon	C12	218,38	
		Heptadecane	Hydrocarbon	C17	240,47	
		Z,Z,Z-alfaofarnesene	Hydrocarbon	C12	204,35	
Myrmecini						
Eutetramorium	Eutetramorium mocquersyi	2,3-Dimethyl-5-(2-methylpropyl)-pyrazine	Amine	C05	164,25	(Tentschert et al., 2000)
Manica	Manica rubida	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Attygalle et al., 1986)
Myrmica	Myrmica lobicornis	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica rubra	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica ruginodis	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica rugulosa	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica sabuleti	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica scabrinodis	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica schencki	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
	Myrmica sucinodis	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Evershed et al., 1981)
Pogonomyrmex	Pogonomyrmex barbatus	2,3,5-Trimethylpyrazine	Amine	C04	122,17	(Hölldobler et al., 2001)
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		2,5-Dimethylpyrazine	Amine	C03	108,14	
	Pogonomyrmex maricopa	2,3,5-Trimethylpyrazine	Amine	C04	122,17	(Hölldobler et al., 2001)
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		2,5-Dimethylpyrazine	Amine	C03	108,14	
	Pogonomyrmex occidentalis	2,3,5-Trimethylpyrazine	Amine	C04	122,17	(Hölldobler et al., 2001)

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GENUS	SPECIES	CHEMICAL COMPOUNDS	FUNCTIONAL GROUP	CHAIN LENGTH	MOLECULAR WEIGHT	REFERENCES
Tetramorium	Pogonomyrmex rugosus	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Hölldobler et al., 2001)
		2,5-Dimethylpyrazine	Amine	C03	108,14	
		2,3,5-Trimethylpyrazine	Amine	C04	122,17	
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		2,5-Dimethylpyrazine	Amine	C03	108,14	
Tetramorium	Tetramorium caespitum	2,5-Dimethylpyrazine	Amine	C03	108,14	(Attygalle and Morgan, 1983, 1984)
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		Methyl 2-hydroxy-6-methylbenzoate	Phenol	C08	166,17	
		2-Methylpyrazine	Amine	C03	94,11	
		2,5-Dimethylpyrazine	Amine	C03	108,14	
Pheidolini	Aphaenogaster impurum	2,3,5-Trimethylpyrazine	Amine	C04	122,17	(Morgan and Ollett, 1987; Morgan et al., 1990)
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
	Tetramorium meridionale	2,5-Dimethylpyrazine	Amine	C03	108,14	
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		(4S)-4-Methylheptan-3-one	Ketone	C07	128,21	
Messor	Aphaenogaster albisetosus	(4R)-4-Methylheptan-3-one	Ketone	C07	128,21	(Hölldobler, 1995)
		(1R)-1-Phenylethanol	Alcohol I	C08	122,16	
		(4S)-4-Methylheptan-3-one	Ketone	C07	128,21	
		anabasine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
Messor	Aphaenogaster cockerelli	2-(Pyridin-3-yl)pyridine	Amine	C09	156,18	(Attygalle et al., 1998a)
		N-Isopentyl-2-phenylethylamine	Amine	C08	191,31	
		anabasine	Amine	C09	162,23	
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		anabasine	Amine	C09	162,23	
Pheidole	Messor bouvieri	anabaseine	Amine	C09	160,22	(Jackson et al., 1989)
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
Pristomyrmex	Messor capensis	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Brand and Mpuru, 1993)
		6-Pentyl-2H-pyran-2-one	Ketone	C10	166,22	
		(R)-dodecan-2-ol	Alcohol II	C12	186,33	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		Acetaldehyde	Aldehyde	C02	44,05	
Crematogaster	Messor dheninus	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Coll et al., 1987)
		3,5-Dimethyl-2-ethylpyrazine	Amine	C05	136,2	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
Atta	Pristomyrmex pungens	2-Phenylacetic acid	Carboxylic acid	C08	136,15	(Do Nascimento et al., 1994)
		bornylene	Hydrocarbon	C09	136,23	
		Octan-1-ol	Alcohol I	C08	130,23	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		anabasine	Amine	C05	136,19	
Crematogaster	Crematogaster castanea	anabasine	Amine	C09	162,23	(Janssen et al., 1997a)
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
Atta	Crematogaster octopinosus	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Morgan et al., 2004)
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
Atta	Atta bisphaerica	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Cross et al., 1982; Evershed and Morgan, 1983)
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
Atta	Atta cephalotes	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Do Nascimento et al., 1994)
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
Atta	Atta cephalotes	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(De Oliveira et al., 1990)
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
Atta	Atta cephalotes	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Riley et al., 1974; Evershed and Morgan, 1983)
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	
		anabaseine	Amine	C09	162,23	
		anabaseine	Amine	C09	160,22	

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GENUS	SPECIES	CHEMICAL COMPOUNDS	FUNCTIONAL GROUP	CHAIN LENGTH	MOLECULAR WEIGHT	REFERENCES
	Atta laevigata	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(De Oliveira et al., 1990)
		Acetaldehyde	Aldehyde	C02	44,05	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		2-Phenylacetic acid	Carboxylic acid	C08	136,15	
		bornylene	Hydrocarbon	C09	136,23	
	Atta sexdens Atta sexdens rubropilosa	Octan-1-ol	Alcohol	C08	130,23	(Robinson and Cherrett, 1978) (Evershed and Morgan, 1983)
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	
		Acetaldehyde	Aldehyde	C02	44,05	
	Atta sexdens sexdens	2,5-Dimethyl-3-ethylpyrazine	Amine	C05	136,19	(Cross et al., 1979) (Evershed and Morgan 1983; Billen et al. 1992, Morgan et al. 2006)
		2,5-Dimethylpyrazine	Amine	C03	108,14	
		2,3,5-Trimethylpyrazine	Amine	C04	122,17	
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		Acetaldehyde	Aldehyde	C02	44,05	
	Atta texana	Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	(Tumlinson et al., 1972) (Sonnet and Moser, 1972)
		Methyl 4-methylpyrrole-2-carboxylate	Amine	C05	139,15	
		Methyl pyrrole-2-carboxylate	Amine	C05	125,13	
		Methyl 2-hydroxy-6-methylbenzoate	Phenol	C08	166,17	
		Dolichoderinae Dolichoderini Dolichoderus Tapinomini Linepithema Tapinoma Formicinae Lasini Lasius	Metapone no tribu Mayriella	Methyl 2-hydroxy-6-methylbenzoate	Phenol	
Dolichoderus thoracicus	(Z)-9-Octadecenal (Z)-9-Hexadecenal		Aldehyde Aldehyde	C18 C16	266,47 238,41	
Linepithema humile Tapinoma simrothi	(Z)-9-Hexadecenal Iridodial Iridomyrmecin		Aldehyde Aldehyde Ketone	C16 C07 C08	238,41 154,21 168,23	
Lasius fuliginosus	mellein 2,3-Dihydro-3,5-dihydroxy-6-methyl-4(H)-pyran-4-one Hexanoic acid Heptanoic acid Octanoic acid Nonanoic acid Decanoic acid		Ketone Ketone Carboxylic acid Carboxylic acid Carboxylic acid Carboxylic acid Carboxylic acid	C10 C06 C06 C07 C08 C09 C10	178,19 144,13 116,16 130,19 144,21 158,24 172,26	

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GENUS	SPECIES	CHEMICAL COMPOUNDS	FUNCTIONAL GROUP	CHAIN LENGTH	MOLECULAR WEIGHT	REFERENCES			
Camponotini Camponotus	Lasius niger	Dodecanoic Acid	Carboxylic acid	C12	200,32	(Bestmann et al., 1992)			
		3,4-Dihydro-8-hydroxy-3,5,7-trimethylisocoumarin	Ketone	C10	206,24				
	Camponotus atriceps	6-sec-Butyl-tetrahydro-3,5-dimethylpyran-2-one	Pyran	C08	184,26	(Haak et al., 2001)			
		geranic acid	Carboxylic acid	C08	168,23				
	Camponotus balzani	8-Hydroxy-3,5,7-trimethylisochroman-1-one	Ketone	C08	206,24	(Kohl et al., 2003)			
	Camponotus castaneus	6-sec-Butyl-tetrahydro-3,5-dimethylpyran-2-one	Pyran	C08	184,26	(Kohl et al., 2003)			
	Camponotus floridanus	6-sec-Butyl-tetrahydro-3,5-dimethylpyran-2-one	Pyran	C08	184,26	(Haak et al., 2001)			
	Camponotus herculeanus	geranic acid	Carboxylic acid	C08	168,23	(Bestmann et al., 1999)			
		(2S,4R,5S)-2,4-Dimethyl-5-hexanolide	Cyclic ester	C06	142,2				
	Camponotus ligniperda	(2S,4R,5S)-2,4-Dimethyl-5-hexanolide	Cyclic ester	C06	142,2	(Bestmann et al., 1999)			
	Camponotus pennsylvanicus	(2S,4R,5S)-2,4-Dimethyl-5-hexanolide	Cyclic ester	C06	142,2	(Kohl et al., 2003)			
	Camponotus rufipes	mellein	Ketone	C10	178,19	(Uebler et al., 1995)			
	Camponotus sericeiventris	8-Hydroxy-3,5,7-trimethylisochroman-1-one	Ketone	C08	206,24	(Kohl et al., 2003)			
	Camponotus silvicola	8-Hydroxy-3,5,7-trimethylisochroman-1-one	Ketone	C08	206,24	(Uebler et al., 1995)			
	Camponotus socius	(2S,4R,5S)-2,4-Dimethyl-5-hexanolide	Cyclic ester	C06	142,2	(Bestmann et al., 1999; Kohl et al., 2001)			
	Camponotus vagus	2,3-Dihydro-3,5-dihydroxy-6-methyl-4(H)-pyran-4-one	Ketone	C06	144,13	(Bestmann et al., 1999)			
		(2S,4R,5S)-2,4-Dimethyl-5-hexanolide	Cyclic ester	C06	142,2				
Ponerinae									
Ectatommini									
Gnamptogenys	Gnamptogenys striatula	4-methylgeraniol	Alcohol I	C08	168,28	(Blatrix et al., 2002)			
		(E)-3,4,7-Trimethyl-2,6-nonadien-1-ol	Alcohol I	C09	182,3				
		(E)-2,(4S)-3,4,7-Trimethyl-2,6-octadienyl decanoate	Carboxylic ester	C10	322,53				
		(E)-2,(4S)-6-3,4,7-Trimethyl-1,2,6-octadienyl dodecanoate	Carboxylic ester	C12	350,58				
Ponerini	Leptogenys diminuta	(3R,4S)-4-Methylheptan-3-ol	Alcohol II	C07	130,23	(Attygalle et al., 1988, 1991; Kern and Bestmann, 1993)			
		isogeraniol	Alcohol I	C08	154,25				
Leptogenys	Leptogenys peuqueti	1-Ethyl-4-methylheptyl acetate	Acetate ester	C08	200,32	(Janssen et al., 1997b)			
		1-Isopropyl-4-methylheptyl acetate	Acetate ester	C08	214,34				
		1-Propyl-4-methylheptyl acetate	Acetate ester	C09	214,34				
		4-Methyldodecan-7-ol	Alcohol II	C11	200,36				
		3,9-Dimethyldodecan-6-ol	Alcohol II	C12	214,39				
		1-Pentyl-4-methylheptyl acetate	Acetate ester	C11	242,4				
		4-Methyltridecan-7-ol	Alcohol II	C13	214,39				
		4-Methyltetradecan-7-ol	Alcohol II	C14	228,41				
		4,10-Dimethyltridecan-7-ol	Alcohol II	C13	228,41				
		1-(3-Methylhexyl)-4-methylheptyl acetate	Acetate ester	C13	270,45				
		1-(3-Methylhexyl)-octyl acetate	Acetate ester	C14	270,45				
		1-Heptyloctyl acetate	Acetate ester	C15	270,45				
		4-Methylhexadecan-7-ol	Alcohol II	C16	256,47				
		1-(3-Methylhexyl)-decyl acetate	Acetate ester	C16	298,5				
		Megaponera	Megaponera foetens	N,N-Dimethyluracil	Amine		C03	140,14	(Longhurst et al., 1979; Janssen et al., 1995)
			actindine	Amine	C08		147,22		

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GENUS	SPECIES	CHEMICAL COMPOUNDS	FUNCTIONAL GROUP	CHAIN LENGTH	MOLECULAR WEIGHT	REFERENCES
Pachycondyla	Pachycondyla tarsata	1,2-Dimethyldisulfate	Sulphur compound	C01	94,2	(Janssen et al., 1999)
		1,3-Dimethyltrisulfate	Sulphur compound	C01	126,26	
		Benzyl methyl sulfane	Sulphur compound	C07	138,23	
		Heptadecan-9-one	Ketone	C17	254,45	
Ectatomminae						
Ectatommini						
Ectatomma	Ectatomma ruidum	geranylgeraniol acetate	Acetate ester	C16	332,52	(Bestmann et al., 1995)
		geranylgeraniol	Alcool I	C16	290,48	
Rhytidoponera	Rhytidoponera metallica	isogeraniol	Alcool I	C08	154,25	(Meinwald et al., 1983)
		3-Hydroxybenzaldehyde	Aldehyde	C06	122,12	
Dorylinae						
Aenictini						
Aenictus	Aenictus sp	Methyl 2-aminobenzoate	Carboxylic ester	C07	151,16	(Oldham et al., 1994)
		Methyl 3-pyridinecarboxylate	Amine	C05	137,14	