

Chemical Secretions of the “Crazy Ant” *Paratrechina longicornis* (Hymenoptera: Formicidae)

by

E. David Morgan¹, Brian D. Jackson¹ & Johan Billen²

ABSTRACT

The Dufour glands of *P. longicornis* contain a group of simple 2-ketones and alkanes, typical of the Dufour glands of many formicine ants. The principal component of the secretion was 2-tridecanone, followed by undecane, 2-pentadecanone and tridecane, with traces of decane, 2-dodecanone, 2-tetradecanone, ethyl phenylacetate and butyl phenylacetate. The venom gland contained, as expected, formic acid. The mandibular glands contained very small amounts of 2,6-dimethylpyrazine, trimethylpyrazine, 3-ethyl-4-methylpentan-1-ol (but not found in all samples), and 4,5-dihydroxydecanoic acid γ -lactone. Ethyl and butyl esters of the common fatty acids were found in heads and abdomens.

Keywords: *Paratrechina longicornis*, crazy ant, gland, secretion.

INTRODUCTION

The ant *Paratrechina longicornis* (Latreille) (Hymenoptera: Formicidae: Formicinae) is widely distributed about the tropical and subtropical parts of the world. It probably originated in Asia or Africa but has been scattered about the world from The Azores to Hawaii by human activity. It also infests buildings in cooler climates and has been found at the top of high-rise buildings. It is known as “the crazy ant” because of its rapid and erratic path when foraging, although it does release a trail pheromone from its hind gut (Blum & Wilson 1964) and does follow trails. It forms large colonies, often inside houses, and the workers forage long distances from their nests, making control of this species difficult. In many parts of the USA it has reached pest status.

No species of *Paratrechina* has yet been examined chemically. The genus belongs to the tribe Lasiini, so we might expect some chemical resemblance to species of *Lasius*, a number of which have been studied in this way. Formicine ants are noted for producing a mixture of simple hydrocarbons and related oxygenated compounds in their Dufour

¹Chemical Ecology Group, Lennard-Jones Laboratory, Keele University, Staffordshire, England, ST5 5BG. E-mail e.d.morgan@chem.keele.ac.uk

²Zoological Institute, K.U. Leuven, Naamsestraat 59, B-3000 Leuven, Belgium. E-mail johan.billen@bio.kuleuven.ac.be

glands (Attygalle & Morgan 1984). The mandibular glands of formicine ants are more variable. A variety of terpenoid compounds have been found in some species (Attygalle & Morgan 1984), in others, only traces of volatile compounds have been found. We report here the composition of the mandibular and Dufour glands of *P. longicornis*.

METHODS

Ants were collected at El Minia in Egypt, in the cultivated area close to the Nile. Body parts were dissected (heads, or mandibles with glands attached; whole abdomens or poison apparatus, consisting of Dufour gland, poison gland and reservoir) and placed immediately in sealed glass capillaries, as described by Morgan (1990), and transported and stored in this way until analyzed.

Analysis was carried out by linked gas chromatography- mass spectrometry (GC-MS) using an Agilent 6890N Gas Chromatograph coupled to a 5973N Mass Selective detector (a quadrupole mass spectrometer using 70 eV electron impact ionization). The system was controlled by a Hewlett Packard computer with MSD ChemStation. The chromatography was carried out on a non-polar column (Hewlett Packard HP-5, 30 m x 0.25 mm with a 0.25 μ m film thickness of methylsilicone) using helium as carrier gas at a constant flow rate of 1 ml min⁻¹. The samples in the sealed glass capillaries were introduced into the gas chromatograph using the solid sampling device described by Morgan (1990). Identification was made initially by mass spectrum using the NIST 2003 computer library of spectra, and for 2-tridecanone confirmed by injection of a synthetic sample.

RESULTS

Essentially no differences were found between analysis of dissected poison apparatuses and whole abdomens. Formic acid (from the poison reservoir) was not quantified. The major substance in the Dufour gland was 2-tridecanone, readily identified by its mass spectral fragmentation pattern and confirmed by injection of an authentic sample. The amount of tridecanone was estimated by injecting known amounts of pure synthetic tridecanone and recording the number of mass spectral counts, and comparing it with the counts given by 1, 5 or 10 abdomens. The average amount per individual worker was 100 ng. This is probably an underestimation since the peaks for tridecanone in abdomens were large and the instrument is not linear for higher concentrations. Tridecanone was followed in quantity by undecane, 2-pentadecanone and tridecane (Fig. 1). Traces of decane, 2-dodecanone, 2-tetradecanone, ethyl phenylacetate and butyl phenylacetate could also be detected.

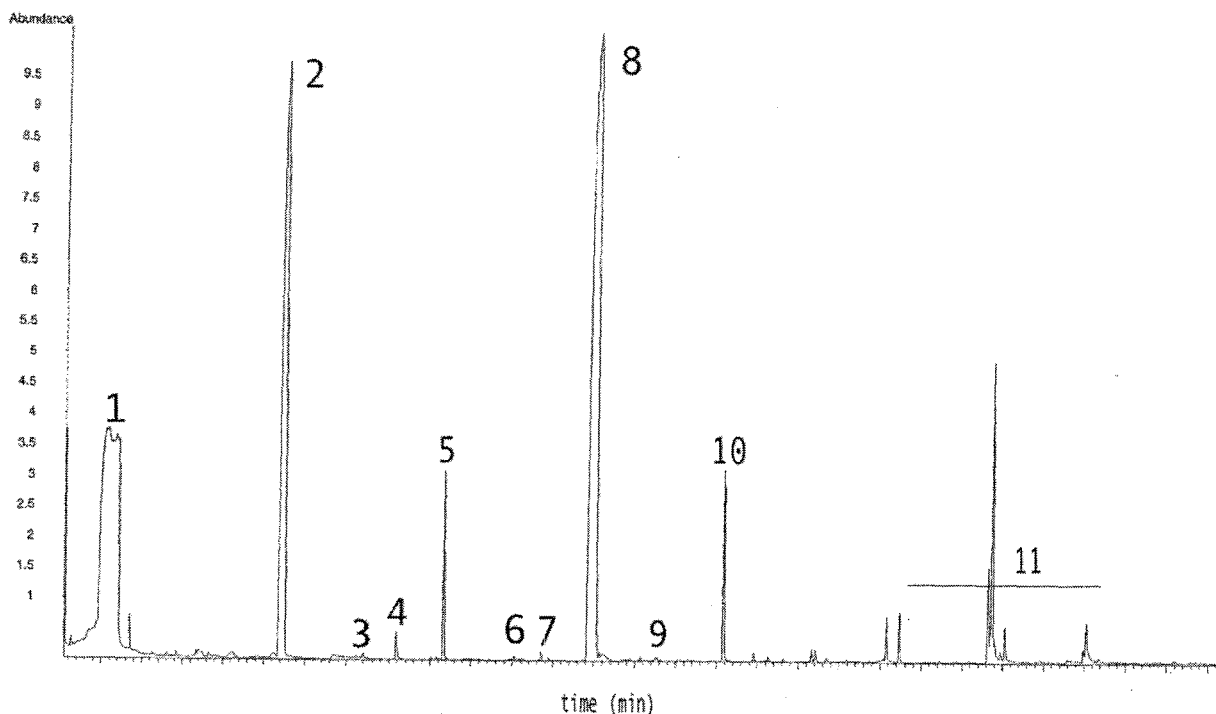


Fig. 1. A gas chromatogram of the Dufour gland contents of *Paratrechina longicornis*. The numbered peaks are: **1** formic acid; **2** undecane; **3** dodecane; **4** ethyl phenylacetate; **5** tridecane; **6** 2-dodecanone; **7** butyl phenylacetate; **8** 2-tridecanone; **9** 2-tetradecanone; **10** 2-pentadecanone; **11** ethyl and butyl esters of the common fatty acids (9 peaks).

The heads and mandibles contained very little volatile material (hence the chromatogram is not shown). Very small amounts (~1 ng) of 2,6-dimethylpazine and trimethylpazine (Fig. 2) were found in all but one out of eight samples, and in one sample containing 10 heads some 3-ethyl-4-methylpentan-1-ol (~10 ng) (Fig. 2) was detected and identified by its mass spectrum (match quality with NIST library 90%). A small peak identified as 4,5-dihydroxydecanoic acid γ -lactone (Fig. 2) (also known as 5-(1'-hydroxyhexyl)-tetrahydrofuran-2-one) by its mass spectrum (NIST Library 2002, spectrum # 131839, match quality 80%) was present in all samples of heads, but not in abdomens.

In both abdomens and heads there were small amounts (comparable with the amount of tridecane in Dufour glands) of the ethyl, and still lesser, butyl esters of the common fatty acids (palmitoleic, palmitic, linoleic, oleic and stearic acids). The amounts and proportions were very constant from sample to sample. Since these esters are present in both body parts, they may be derived from the cuticle, but this was not confirmed.

DISCUSSION

Undecane and 2-tridecanone (Fig. 2) were first identified among insects in the ant *Lasius umbratus* (Quilico *et al.* 1957). Undecane is almost the signature compound of the Dufour glands of formicine ants

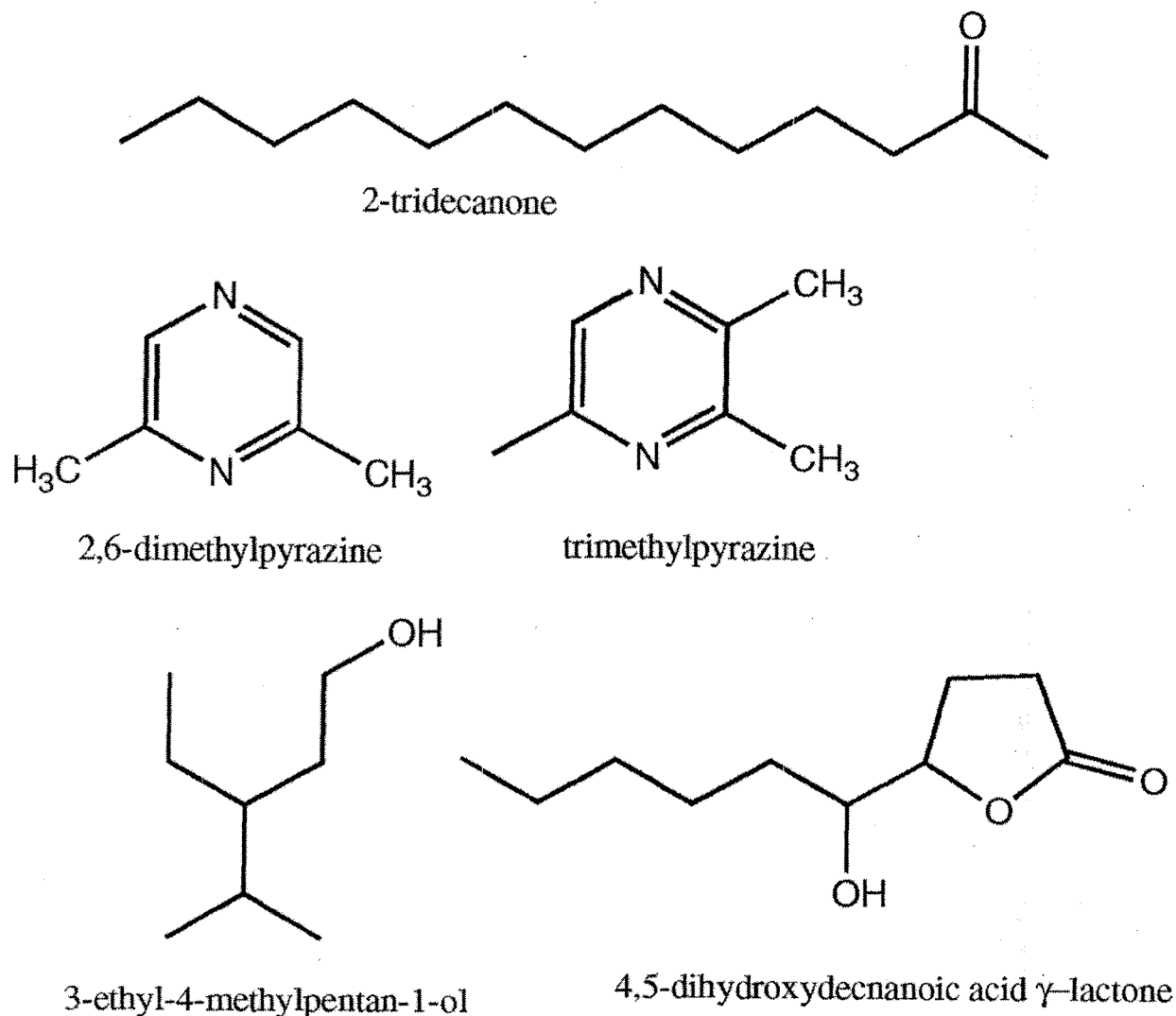


Fig. 2. Some of the compounds found in the glands of *Paratrechina longicornis*. The stereochemistry of 3-ethyl-4-methylpentan-1-ol and 4,5-dihydroxydecanoic acid γ -lactone is unknown.

(Blum 1981), and is found in the Dufour gland of most species yet studied. Bernardi *et al.* (1967) found in whole abdomens of *Lasius fuliginosus* undecane the major substance, with 2-pentadecanone next, and other hydrocarbons and 2-ketones. Bergström & Löfqvist (1970) examined four species of *Lasius* (*L. niger*, *L. alienus*, *L. flavus* and *L. carnolicus*) and found undecane the major substance in the gaster, along with other C₁₀ to C₁₉ hydrocarbons, 1-alcohols, 1-acetates and, in two species 2-tridecanone and higher 2-ketones, and occasionally other related aliphatic compounds. The compounds found in the heads of the workers of these species were more variable. They found traces only of 1-octanol and 1-nonanol in *L. niger*, traces of 2,3-dihydrofarnesal in *L. alienus*, traces of the same dihydrofarnesal and citronellal in *L. flavus*, but large amounts of citronellal and geranyl citronellal in *L. carnolicus*. Attygalle *et al.* (1987) re-examined the Dufour gland of *L.*

niger and listed 50 compounds there, but the major ones were undecane and dodecyl acetate. Cammaerts *et al.* (1988) showed that dodecyl acetate attracted workers of *L. niger* and induced them to walk more quickly. Without giving a comprehensive review of the known substances of the Dufour glands of *Lasius* ants, the substances found here in *P. longicornis* are typical of those in related species.

The combination of formic acid with 2-tridecanone is a defensive strategy used by other insects. Attygalle *et al.* (1993) showed that the caterpillars of the notodontid moth *Schizura unicornis*, when disturbed, spray a mixture of formic acid and a non-acidic secretion dominated by 2-tridecanone. Other notodontids and some carabid beetles also employ this two-phase sort of defensive spray, usually from a two-chambered gland (analogous to the Dufour and poison glands of formicine ants) (references in Attygalle *et al.* 1993). The non-acidic portion is thought to act as a spreading agent for the formic acid, but 2-tridecanone has intrinsic deterrence for insects, and is found in the glandular hairs of wild tomato plants (Williams *et al.* 1980).

The presence of alkylpyrazines in mandibular glands is not uncommon, especially in ponerine ants (Morgan *et al.* 1999), but the presence of 3-ethyl-4-methylpentan-1-ol is particularly interesting. This compound was first identified in the heads of five species of *Formica* (Bühning *et al.* 1976; Francke *et al.* 1980; 1985), and was identified by us in *F. sanguinea* mandibular glands and we studied the quantity of it present in workers of increasing age (Moens *et al.* 1990). It was also found to be the major substance in the mandibular glands of workers of *F. fusca*, the potential slaves of *F. sanguinea* (Jackson 1991). The chromatograms of worker heads were searched carefully for traces of the related compounds found in *F. sanguinea* (3,4-dimethylpentan-1-ol, methyl 3-ethyl-4-methylpentanoate, and 3-ethyl-4-methylpentan-1-yl 3-ethyl-4-methylpentanoate), but none of them were found.

On the evidence available from these glandular secretions, this species of *Paratrechina* is similar to its near relatives of *Lasius* and *Formica* ants.

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