with corticosterone are those of Fekete et al.[6]. Unfortunately, these authors measured effects on dopamine concentrations only, which they found to be unaltered in a number of hypothalamic nuclei including the arcuate nucleus and the median eminence. Furthermore, they carried out their study in intact rats. In intact rats corticosterone occupies its receptors in the brain to an extent more than 80%[4]. An involvement of brain corticosterone receptors, therefore, seems to be less likely in the experiments of Fekete et al.[6]. There is no evidence in favor of a role of brain dopamine in the regulation of ACTH secretion, though this catecholamine participates in the control of the release of other pituitary hormones[7]. Increases in the utilization of noradrenaline and adrenaline in the arcuate nucleus, median eminence, lateral septal nucleus, paraventricular nucleus and dorsomedial nucleus were found in ADX as well as in S-ADX rats. This indicates that these increases are due to the stress of the exposure to ether and the operation and not to differences in the amount of circulating corticosterone, which is low in ADX rats and high in S-ADX rats (see table 2). These increases were found in hypothalamic nuclei, in which changes in catecholamine concentrations have already been observed after various stresses[8–11], and are in accordance with the hypothesis that stress causes an activation of various catecholamine systems in the brain[8–16].

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Composition and novel pattern of emission of defensive scent oils in the larva of the cotton seed bug *Oxycarenus hyalinipennis* (Costa) (Heteroptera: Lygaeidae)[1]

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Summary. Differences in composition and pattern of emission in the scent oils from the two abdominal scent glands in the larva of *Oxycarenus hyalinipennis* are reported. The scent oils contain hex-2-enal, oct-2-enal, dec-2-enal and 4-oxo-oct-2-enal.

Defensive scent glands are widely present in Heteroptera[2,3]. Volatile fatty aldehydes, ketoaldehydes, esters and other biosynthetically related materials, sometimes together with isoprenoids, have been identified as components of their often complex secretions[4]. However, there has been as yet little investigation of the factors conditioning intraspecies and interspecies variation in scent oil composition. In this contribution to the problem we correlate differences in scent oil composition with differences in pattern of emission in the 2 abdominal scent glands in the larva of the cotton seed bug *Oxycarenus hyalinipennis* (Costa)[1].

Material and methods. The bugs[5,6] were maintained at 26 °C on dry cotton seeds and drinking water under a 14 L: 10 D photoperiod. Scent glands were excised from chilled larvae under 200 mM NaCl. Gas chromatography-mass spectrometry (GC-MS) was performed in both the electron impact (EI) and chemical ionization (CI) modes. For CI-GC-MS ammonia was used as reagent gas. The 7070H VG mass spectrometer was operated at 70 eV with the ion source at 190 °C, separator 180 °C and 200 μA ionizing current. Separations were achieved with a 2 m × 2 mm i.d. glass column packed with 3% OV 225 on 100–120 mesh Gas Chrom Q: 10 ml helium/min, column isothermal at 70 °C for 5 min and then temperature programmed to 200 °C at 10 °C/min. For routine gas chromatography (GC) a Varian 1440 instrument equipped with flame ionization detector was used. Injection of glandular samples was effected by a solventless open column procedure[7]. Dodecane supplied the external standard (1 μl dodecane in 1 ml of acetone).

Results. GC analysis of the secretions yielded 7 peaks of which 4 peaks (95% of the total) were identified as follows. Peak 2, hex-2-enal; base peak m/z 41, major ions at 55, 69 and 83, prominent M^+ 98 and M-1, matching the mass spectrum (MS) of authentic (E)-hex-2-enal (Aldrich). Peak 5, oct-2-enal; base peak m/z 41, major ions at 55, 70 and 83, matching the MS of authentic (E)-oct-2-enal (PPF International). Peak 6, dec-2-enal; base peak m/z 43, major ions at 55, 70 and 83, matching the MS of authentic (E)-dec-2-enal (PPF International). Peak 7, 4-oxo-oct-2-enal; base peak m/z 98, major ions at 55, 83 and 111, prominent M^+ 140, matching the MS published for (E)-4-oxo-oct-2-enal[8]. Molecular ions for oct-2-enal (M + 126)

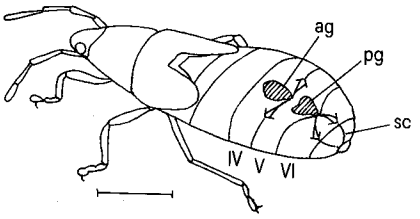

Figure 1. Larva of *Oxycarenus hyalinipennis*, dorsal view, showing pattern of emission of scent oils from the abdominal scent glands; ag, anterior gland; pg, posterior gland; sc, scent canal. Roman numerals (IV, V, VI); abdominal segments 4, 5 and 6. Scale line = 0.1 mm.

Composition of abdominal gland scent oils

Component number (RT)*	Identity	Composition (%) Anterior gland	Posterior gland
1	–	0.1	–
2 (1)	hex-2-enal	1.2	0.1
3	–	1.6	0.9
4	–	0.8	0.1
5 (2.7)	oct-2-enal	93.5	34.0
6 (9)	dec-2-enal	2.3	28.0
7 (10)	4-oxo-oct-2-enal	0.5	37.0
Sample volume (µl)		0.0058	0.0066

* In order of elution (GC) from column packed with 3% OV 225 on Gas Chrom. Q. Retention times (RT min) for column at 100 °C and 30 ml nitrogen/min.

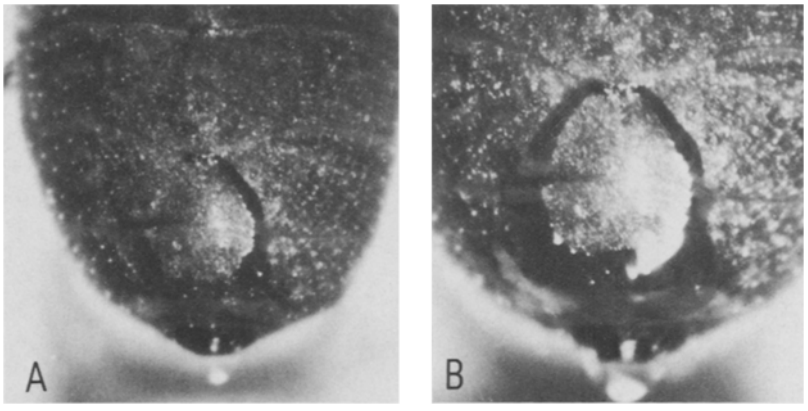

Figure 2. Photographs of abdominal extremity of abdomen, dorsal view, showing patterns of emission of scent oil from the posterior scent gland. *A* Unilateral discharge from the paired ostioles of the gland opening; *B* bilateral discharge. The abdominal extremity supports a droplet of rectal fluid.

and dec-2-enal (M + 154) were not observed but CI-GC-MS analysis yielded prominent quasimolecular ions (M + H) for these components. GC retention times of the *Oxycarenus* alk-2-enals and authentic standards also matched. No standard material was available for comparison with 4-oxo-oct-2-enal which eluted on the tail of the dec-2-enal peak. Production of the *Oxycarenus* scent volatiles by other Heteroptera has been reported[4] and a role for fatty aliphatic aldehydes in the defense of Heteroptera against ants and other small arthropod predators demonstrated[9].

The 2 glands showed organ-specific differences in scent oil composition (table). Oct-2-enal (94% of the total) was greatly predominant in the anterior gland but relatively reduced in the posterior gland (34%) where it was accompanied by dec-2-enal (28%) and 4-oxo-oct-2-enal (37%) as major components (results from an individual larva but typical of 4 sets that were obtained from mature larvae). The differences were not apparently connected with sample volume[10,11] which was similar in the 2 samples (table). Differences in the pattern of emission of scent oil from the 2 glands were also observed (fig. 1). Anterior gland; the ejected oil passes laterally to accumulate in a droplet on the IV-V intersegmental boundary where unless removed by contact it is eventually lost, apparently by evaporation. Posterior gland; the ejected oil issues from the paired ostioles of the gland opening evidently to flow along open scent canals extending over abdominal tergites VI and VII (fig. 2A, unilateral discharge, 2B, bilateral discharge). The scent canals, as seen in scanning electron micrographs (fig. 3), are lined with numerous 2 µm apart epicuticular projections and lack the raised polygonal pattern which defines primary epidermal cell boundaries in adjacent cuticle. Their position can be further shown experimentally

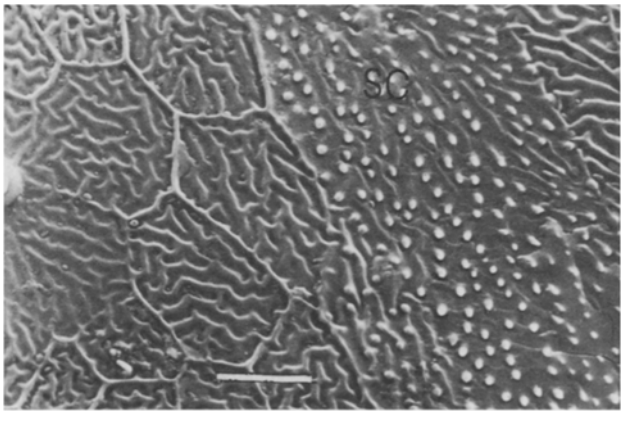

Figure 3. Scanning electron micrograph showing surface structure of scent canal (SC, tergite VI, right hand side). Scale line = 10 µM.

by deposition of octanol on tergite VI or VII. From observation it seems that the presence of oil in the scent canals facilitates the flow of rectal fluid, a copious release of which frequently accompanies the release of scent oil, onto tergite VII. A 3.4 mg larva can eject up to 0.007 µl of oil from each gland and up to 0.6 µl of rectal fluid when disturbed by handling.

Discussion. The larva of *O. hyalinipennis* is an addition to the list of Heteroptera now known to show organ specific differences in scent oil composition[3]. We can find no previous reference to the occurrence of scent canals in Heteroptera larvae[12] although structures analogous to those

described here in *O. hyalinipennis* larvae are frequently present in their adults[2,3,9]. We offer the working hypothesis that the oil filled scent canals of the larva in *O. hyalinipennis* supply a mechanism aiding the accumulation of rectal fluid, a defensive fluid in its own right, on the posterior abdominal tergites by surface forces. A decrease in lipophilicity associated with selective accumulation of 4-oxo-oct-2-enal in the posterior abdominal scent gland in the larva of *Oncopeltus fasciatus* has been noted[13]. Although other varieties of explanation for the occurrence of organ specific differences in scent oil composition are possible (pheromonal, allomonal)[14] we have no evidence at present for supposing that any of these are applicable in the case of the larva in *O. hyalinipennis*.

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