γ-Decalactone, an Odoriferous Compound from the Male Butterfly, *Lethe marginalis* Motschulsky

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Lethe marginalis Motschulsky, Satyridae, Male Scent Secretion, Fore and Hind Wings, γ-Decalactone

The scent secretions of *Lethe marginalis* (Satyrid butterfly) were investigated by means of GC and GC-MS. The scent substance is found to be γ-decalactone.

Some studies on the chemical structure and physiological functions of scent substances of butterflies have been reported: *e.g.* the presence of neral, geranial and geraniol in the scent scales of *Pieris napi* (Pieridae) found by Bergstrom *et al.* [1] and then Hayashi [2], Kuwahara [3] also reported the scent substances of *P. napi* and *P. melete* (Pieridae) distributed in Japan. The presence of nonanal, hexadecyl acetate and torreyol (δ-cadinol) in the scent scales of *Lycalides argyrognomon* (Lycaenidae) was observed by Lundgren *et al.* [4].

Rutowski [5] reported the function and localization of male scent substances of *Colias philodice* (Pieridae), while Grula [6] have been reported the presence of *n*-hexyl esters (myristate, palmitate, stearate) and 13-methyl-heptacosane in the same species. Honda [7] reported the presence of some aromatic compounds (benzaldehyde, phenylacetaldehyde, 2-phenylpropenal), aliphatic ketones (*n*-heptanal, 6-methylhept-5-en-2-one), and linalool from the scents of *Atrophaneura alcinous* (Papilionidae). Recently Hayashi (8) reported the presence of *E*-β-ocimene as the scent substance of both sexes of *Hebomoia glaucippe* Linnaeus.

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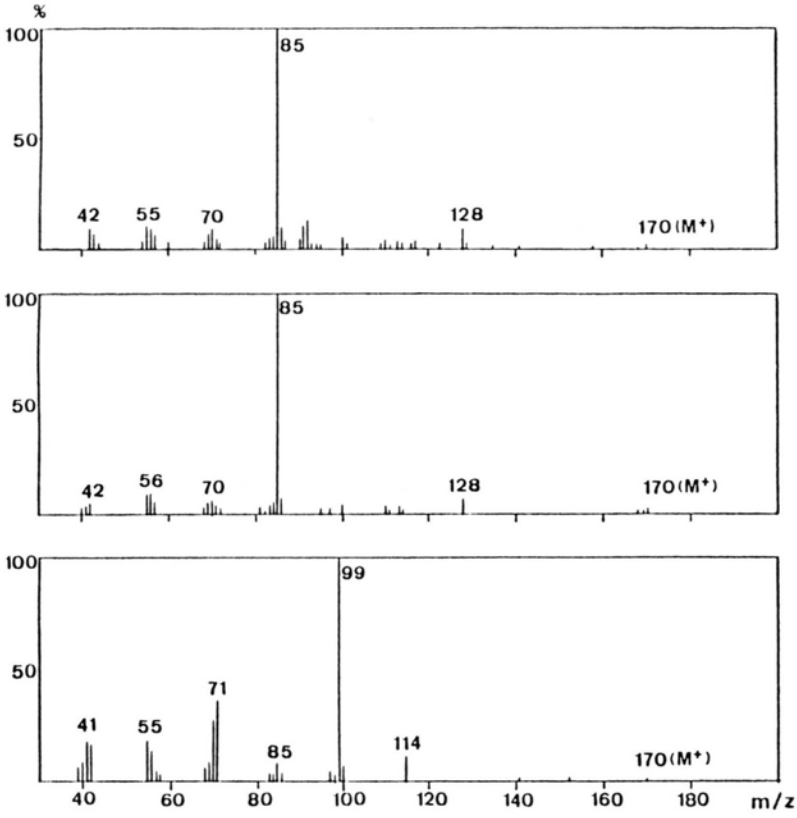
About 40 years ago, Tinbergen [9] reported the courtship behaviour of *Eumensis semele* (Satyridae) and suggested the presence of scent substances in the male fore wings. In the course of the chemical study of the scent substances of Satyrid butterflies, the constituents of the scent secretion of *Lethe marginalis* (Satyridae) were investigated by means of GC and GC-MS.

Material and Method

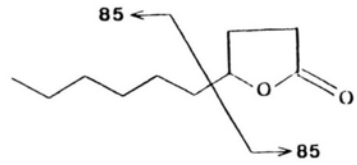
The adults of both sexes of *Lethe marginalis* Motschulsky were captured during July and September in Yamanashi and Hiroshima Prefecture in Japan. The number of males and females used in this study were 100 heads respectively. The scents of male wings are faintly sweet and give associations with peach, sweet osmanthus, and apricot, while the females have usually considered to lack wing scents. The wings and bodies (head, thorax, abdomen were treated together) were amputed immediately, and the wings and bodies were extracted separately for 24 h at room temperature with 150 ml of diethyl ether. The extracts of the male and female were concentrated to 10 µl under a nitrogen stream at room temperature. 1 µl of each sample were injected into gas chromatograph (GC) and gas chromatograph-mass spectrometer (GC-MS). Analyzes by GC were carried out with a Shimadzu GC-9A gas chromatograph which was combined with an electric integrator and equipped a flame ionization detector on OV-1 fused silica capillary column (0.25 mm × 50 m) at 170 °C isothermally. The quantity of γ-decalactone in the wings and bodies were determined by comparing with the integration of the peak area on GC with those of reference standard solutions of γ-decalactone. Analyzes by GC-MS were conducted with a JEOL JGC-20KP as chromatograph and JEOL JMS-D100 mass spectrometer. Analytical condition were as follows: column temperature, 200 °C; injection temperature, 200 °C; ionization voltage, 25 eV.

GC of the scent substances of both wings revealed two peaks at R_t 8.8 and 12.6. By GC-MS, the first peak (R_t 8.8 in the GC) shows the ions at *m/z* 43, 57, 71, 85, 99, 184 (M^+) characteristic of paraffin hydrocarbons and identified as *n*-tridecane with both GC and GC-MS. MS (Figure) of the second peak (R_t 12.6) shows the base peak at *m/z* 85 together with the ions at *m/z* 128, and 170 (M^+) identified as γ-decalactone comparing with those of authentic specimen

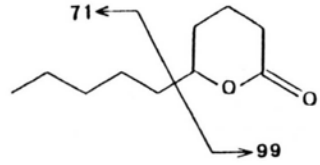


[a] Lethe marginalis Motschulsky

[b] γ-decalactone



[c] δ-decalactone



(synthesized from the corresponding α-decenoic acid with conc. H_2SO_4). Further identification was carried out by GC. The contents of γ-decalactone in the wings and bodies of male butterflies are as following: male fore wing, 80 ng, male hind wing, 73 ng for a head; male body, no detected. No γ-decalactone is detected from the female wings and bodies.

The contents of γ-decalactone in male wings are very small quantity comparing with the scent substances of pierid butterflies [8].

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