

CHROM. 9609

Note

Cannabis

XVI*. Constituents of marihuana smoke condensate

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Although interest in the constituents of marihuana smoke condensate is increasing, until now relatively few components have been identified²⁻⁶, with the exception of 153 polynuclear aromatic hydrocarbons, which were shown to be present during a comparative investigation of marihuana and tobacco smoke condensate by Lee *et al.*⁷.

In this paper, we report a number of constituents that were identified during the preliminary stages of our research on marihuana smoke.

EXPERIMENTAL

Gas chromatography (GC) was carried out with a Becker 417 gas chromatograph using either a glass column (200 × 0.3 cm I.D.) containing 3% OV-17 on Chrompack SA, 80-100 mesh, or an LKB 2101-202 glass capillary column (25 m × 0.22 mm I.D.) containing OV-101 (72,700 theoretical plates), with nitrogen as the carrier gas. A programmed column temperature, a detector temperature of 300° and an injection block temperature of 220° were used.

Gas chromatography-mass spectrometry (GC-MS) was carried out using a modified JEOL JMS-07 instrument with a double-stage separator, using a glass column (200 × 0.3 cm I.D.) containing 3% OV-17 on Chrompack SA, 80-100 mesh, with helium as carrier gas. The temperature of the injection block was 210° and the separator 220°, the column was temperature programmed and the ion source was operated at 230°. The accelerating voltage was 3 kV and the trap current 300 μA. Spectra were obtained by recording the total ion current at 30 eV.

A Borgwaldt RI/AO1 smoking machine was used, taking 2-sec puffs, once per minute with an air velocity of 1150 ml/min.

Condensate was collected from 640 cigarettes (hand-rolled from Mexican marihuana, code Ma 2, C-69; Δ¹⁽²⁾-tetrahydrocannabinol content 1.29%; standard length and diameter, 0.65 g each; stored for 48 h at a relative humidity of 75%). The condensate was dissolved in diethyl ether and basic (0.3 g), acidic (0.3 g), phenolic

* Part XV: see ref. 1.

(1.6 g) fractions separated from neutral components (6.9 g) by extracting the ethereal solution with 1 *N* hydrochloric acid, saturated sodium carbonate and 2 *N* potassium hydroxide solution, respectively. The neutral fraction was chromatographed on silica gel (100 g of silica gel for 5 g of material), by subsequent elution with *n*-hexane, *n*-hexane-benzene (3:1), benzene, diethyl ether and methanol (500 ml of each solvent for 5 g of material). Fractions of 100 ml were taken throughout and were analyzed by GC and GC-MS. The acidic, phenolic and basic fractions were analyzed in the same way, but without pre-fractionation.

RESULTS AND DISCUSSION

The peaks in the gas chromatogram were identified by comparing the mass spectra with either the spectrum of an authentic sample or with the spectrum as known from literature. Gas chromatographic retention times were checked where possible. The following products were found for the first time in marijuana smoke condensate:

Acidic fraction: phenylacetic acid, β -phenylpropionic acid, *p*-hydroxybenzaldehyde, vanillin and 2-hydroxy-3-methyl-2-cyclopenten-1-one.

Phenolic fraction: *o*-dimethylphenol, β -naphthol and 4-methylguaiacol.

Neutral fraction: benzaldehyde, acetophenone, propiophenone, benzonitrile, tolunitrile, benzyl cyanide, β -phenylethyl cyanide, three dimethyl- or ethylindoles*, one trimethyl-, methylethyl- or propylindole*, three methylcarbazoles*, one dimethyl- or ethylcarbazole*, furfural, 5-methylfurfural, 2-acetylfuran, 5-methyl-2-acetylfuran, 4-hydroxy-6-*n*-pentylbenzofuran, 5-hydroxy-7-*n*-pentyl-2H-chromene or 4-hydroxy-2-methyl-6-*n*-pentylbenzofuran, 2,2-dimethyl-5-hydroxy-7-*n*-pentyl-chromene, cannabifuran^{8,9}, dehydrocannabifuran^{8,9}, 2-oxo- $\Delta^{3(4)}$ -tetrahydrocannabinol^{8,9}, cannabichromanone^{8,9}, $\Delta^{1(2)}$ -tetrahydrocannabinol methyl ether and cannabinol methyl ether.

Basic fraction: two dimethyl- or ethylpyridines, one trimethyl-, methylethyl- or propylpyridine, quinoline, methylpyrazine, 2,5-dimethylpyrazine, 2,6-dimethylpyrazine, methylethylpyrazine, one dimethylethyl-, diethyl-, methylpropyl- or butylpyrazine (not tetramethylpyrazine), norharman and harman.:

Although the compounds that we have identified have not previously been found in marijuana smoke condensate, many of them occur in tobacco smoke condensate and in roasted products such as coffee and cocoa¹⁰⁻¹⁵ (the cannabinoids are specific to marijuana, however). Harman and norharman may be worth mentioning because of their physiological activity, although they also occur in tobacco smoke.

Preliminary pharmacological testing (SINDROOM test¹⁶) showed that the basic fraction is the most active. A capillary gas chromatogram (glass column) of this fraction contains about 400 peaks, only a few of them being major components. We are currently examining this fraction for further constituents which may contribute to the effect(s) of marijuana smoking.

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* Substituted indoles and carbazoles were also mentioned by Lee *et al.*⁷.

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EDITOR'S NOTE

When this paper was received, the paper by Maskarinec *et al.*¹⁷ had not been published.

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