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# PHOTOCHEMICAL DECOMPOSITION OF CANNABIDIOL IN ITS RESIN BASE

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**Key Word Index**—*Cannabis sativa*; Cannabaceae; hemp; irradiation; decomposition; terpenophenolics; cannabidiol; $\Delta^9$-tetrahydrocannabinol.

**Abstract**—Cannabidiol in fiber-type *Cannabis sativa* resin from floral tissues showed a gradual and consistent decline over time when irradiated with 1320 kJ/m²/day of UV and visible radiation. The concentration of $\Delta^9$-tetrahydrocannabinol in the resin was not affected by the treatment. Therefore, the trace amounts of $\Delta^9$-tetrahydrocannabinol detected in some fiber-type *C. sativa* are probably not of photochemical origin.

## INTRODUCTION

*Cannabis sativa* plants are generally classified into one of two chemotypes, i.e. either high cannabidiol (CBD or fiber-type) or high $\Delta^9$-tetrahydrocannabinol ($\Delta^9$-THC or drug-type).

Many fiber-type plants contain low or trace amounts of $\Delta^9$-THC [1–4]. *In vivo* and *in vitro* conversions of cannabidiolic acid (CBDA) to $\Delta^9$-tetrahydrocannabinolic acid ($\Delta^9$-THCA) occurred with drug-type plants but not with fiber chemotypes [5, 6]. The authors suggested that fiber-type plants lack the enzyme (or enzymes) necessary to convert CBDA to $\Delta^9$-THCA. This implies that abiotic factors may be responsible for the production of the trace amounts of $\Delta^9$-THC often detected in fiber-type plants.

CBD, the decarboxylated product of CBDA, can be photochemically converted to $\Delta^9$-THC when dissolved in cyclohexane or *n*-hexane and irradiated with UV radiation [7, 8]. Thus, the trace amounts of $\Delta^9$-THC found in some fiberous *C. sativa* may result from such photochemical transformations. The objective of this study was to test whether UV irradiation of fiber-type *C. sativa* resin results in a conversion of CBD to $\Delta^9$-THC.

## RESULTS AND DISCUSSION

Natural cannabinoids in fresh plant tissue exist as acids [9–11]. The acidic cannabinoids (such as $\Delta^9$-THCA) are readily decarboxylated to their neutral form (such as $\Delta^9$-THC) upon storage or injection into a heated gas chromatograph [12, 13]. Thus, gas chromatography provides a simple means of quantifying the total natural, acidic cannabinoid content in the resin. There was no significant difference in the concentration of $\Delta^9$-THC or cannabichromene (CBC) after irradiating a resin concentrate (extracted from floral tissue of a fiber-type plant of *C. sativa*) with 1320 kJ/m²/day of UV and visible radiation continuously for up to 7 days (Fig. 1). The irradiated resin, however, did show a gradual and consistent decline in CBD content with time. The resin contained 11% less CBD after 7 days of continuous irradiation as compared to day 0. The decrease of CBD with time resulted from photochemical decomposition because dark control samples collected on day 7 were not significantly different from those collected on day 0 (396 and 399 mg, respectively). However, this decrease in CBD upon irradiation was not associated with an increase in $\Delta^9$-THC or other natural cannabinoids. Cannabinol (CBN), the degradation product of CBD and $\Delta^9$-THC, was not detected in the samples. Considering that the UV dose used in the present study was far in excess of that received anywhere on earth, photochemical conversions of CBD to $\Delta^9$-THC probably do not occur when CBD is in its natural resin matrix *in situ*. The source of $\Delta^9$-THC in fiber-type plants remains unknown.

## EXPERIMENTAL

A fiber-type *Cannabis sativa* L. plant, originating from seed of a Czechoslovakian population (coded CZ-G) was cloned from a vegetative cutting as described by Coffman and Gentner [14] at USDA, Beltsville, MD. The rooted cutting was transferred to a 0.6 l. plastic pot containing Metromix 300 potting mixture (composed of composted bark, peat moss, vermiculite, perlite, granite and sand) and watered daily, alternating between tap water and a dilute soln of Peters 20-20-20 general purpose fertilizer containing 7.3 mmol N, 0.7 mmol P and 1.0 mmol K. The plant was transferred to 0.3 l. larger pot approximately every 2 months to prevent root binding. After 9 months, 50 g fresh weight of floral tissue was harvested and immediately sonicated in 500 ml *n*-hexane for 30 sec. The latter step stripped resin from the glands without extracting the internal leaf components (as determined by the absence of chlorophyll in the resin concentrate). The resulting soln was filtered, evaporated to dryness under vacuum at room temp. and redissolved in 5 ml *n*-hexane. Concentrated resin soln (100 μl) was spotted on Whatman No. 1 filter paper and irradiated continuously at 28° with UV and visible radiation at an unweighted daily dose of 1320 kJ/m² (5 k/m² UV-C + 643 k/m² UV-B + 461 kJ/m² UV-A + 211 kJ/m² 400–800 nm), supplied from two unfiltered Westinghouse FS-40 sunlamps 0.1 m from the samples.

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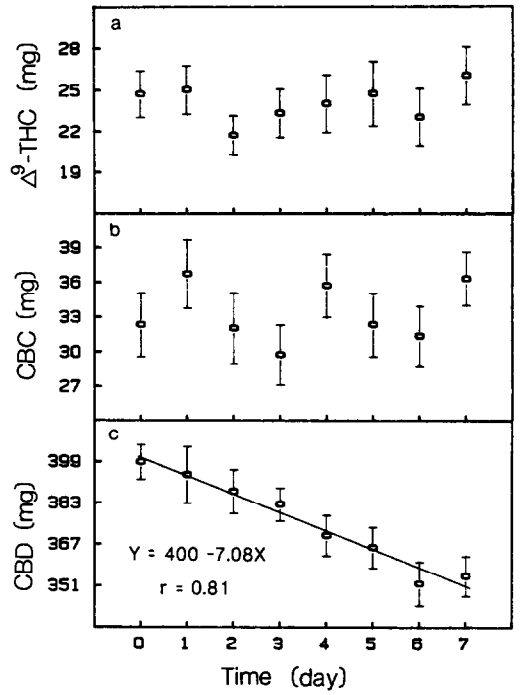


Fig. 1. Effects of UV-B radiation on the decomposition of (a) $\Delta^9$-THC, (b) CBC and (c) CBD in resin concentrate from fiber-type *Cannabis sativa*, spotted on filter paper, kept at 28° and irradiated continuously with a combination of UV and visible radiation at an unweighted daily dose of 1320 kJ/m² (5 kJ/m² UV-C + 643 kJ/m² UV-B + 461 kJ/m² UV-A + 211 kJ/m² 400–800 nm), supplied from two unfiltered Westinghouse FS-40 sunlamps 0.10 m from the samples. The vertical lines represent ± 1 s.e.

Subsamples were collected daily in triplicate after up to 7 days of irradiation (non-irradiated samples were also collected on day 7), extracted with *n*-hexane, evaporated to dryness under vacuum at room temp. and redissolved in 0.5 ml *n*-hexane containing 5 μg/μl of *n*-hexacosane (the internal standard).

Chemical analysis was performed using GC equipped with a FID and a 6.4 mm o.d., 2 mm i.d. by 2.43 m glass column packed with 3% SP-2100. The inlet and detector temps. were 240 and 260°, respectively, while the column was operated isothermally at 190°. He was the carrier gas at 20 ml/min. Statistical analysis was done using one-way analysis of variance [15]. Linear regression analysis was used where radiation effects were found to be significant ($P < 0.05$) by analysis of variance.

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