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Potency Trends of Δ^9-THC and Other Cannabinoids in Confiscated Marijuana from 1980–1997

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ABSTRACT: The analysis of 35,312 cannabis preparations confiscated in the USA over a period of 18 years for delta-9-tetrahydrocannabinol (Δ^9-THC) and other major cannabinoids is reported. Samples were identified as cannabis, hashish, or hash oil. Cannabis samples were further subdivided into marijuana (loose material, kilobricks and buds), sinsemilla, Thai sticks and ditchweed. The data showed that more than 82% of all confiscated samples were in the marijuana category for every year except 1980 (61%) and 1981 (75%). The potency (concentration of Δ^9-THC) of marijuana samples rose from less than 1.5% in 1980 to approximately 3.3% in 1983 and 1984, then fluctuated around 3% till 1992. Since 1992, the potency of confiscated marijuana samples has continuously risen, going from 3.1% in 1992 to 4.2% in 1997. The average concentration of Δ^9-THC in all cannabis samples showed a gradual rise from 3% in 1991 to 4.47% in 1997. Hashish and hash oil, on the other hand, showed no specific potency trends. Other major cannabinoids [cannabidiol (CBD), cannabinol (CBN), and cannabichromene (CBC)] showed no significant change in their concentration over the years.

KEYWORDS: forensic science, marijuana, GC, analysis, potency, cannabinoids, Δ^9-THC

Cannabis and its preparations (loose marijuana, kilobricks, buds, sinsemilla, Thai sticks, hashish and hash oil, etc.) are the most widely used group of illicit drugs in the world. Efforts to evaluate the health problems associated with cannabis have produced conflicting results (1,2). The different biological effects of cannabis (3,4) are attributed to the complex chemical composition of the plant material (5,6). In addition, the chemical profile of the various variants of marijuana are certainly different and could contribute to the variability of results between investigators. Therefore, the chemical analysis of confiscated material becomes important in understanding the health problems associated with the abuse of the drug.

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Review of the literature dealing with confiscated marijuana and other cannabis preparations revealed that analyses were typically carried out for the identification of the drug for legal or forensic science purposes (7–10) or to identify the country of origin (11–15).

In previous publications (16,17), we have reported on the analysis of different forms of marijuana confiscated between 1972 and 1983. The present report covers the period of 1980–1997 where the analysis of a total of 35,213 cannabis preparations confiscated in the United States was carried out. Statistical analysis of the differences in the mean Δ^9-THC concentration from year to year was also carried out to ascertain the trend in the change in marijuana potency over time. Data on hashish and hash oil are also presented.

Experimental

Samples

All samples analyzed in this investigation were confiscated during the years 1980 through 1997 by law enforcement agencies in the USA including the Drug Enforcement Administration (DEA) as well as state and local police and narcotic agents. Samples were classified according to their physical characteristics into the following categories.

Cannabis Samples—These are all samples received as the raw plant material which could be classified into: marijuana, sinsemilla, Thai sticks and ditchweed. a) Marijuana: Samples classified under the general type of marijuana are found usually in three forms: i) Loose marijuana: when samples are received in the form of loose cannabis plant material with leaves, stems and seeds. ii) Kilobricks: cannabis compressed in the form of a kilobrick (classical Mexican packaging) with leaves, stems and seeds. iii) Buds: cannabis in the form of buds or flowering tops of the female plant with seeds. b) Sinsemilla: cannabis in the form of flowering tops of the female plant (no seeds). c) Thai sticks: cannabis in the form of leafy material tied around a small stem, a classical form produced in Thailand. d) Ditchweed: Fiber type cannabis grown wild in the Midwestern region of the USA.

Hashish Samples—Hashish is composed mainly of the resin of the cannabis plant, mixed with some plant particles and shaped into a variety of forms such as balls, sticks or slabs which are very hard, dark green or brownish colored.

Hash Oil Samples—Hash oil is a liquid or semi-solid preparation which is basically a concentrated extract of the cannabis plant ma-

terial. Depending on the process used to prepare hash oil, it is usually dark green but could be amber or brownish in color.

All samples used in this study were received by the laboratory within a few weeks after being seized and the analysis was carried out shortly thereafter. Samples were stored at room temperature with a dedicated air conditioning system keeping the temperature below 20°C.

Domestically Cultivated Cannabis—cannabis preparations known to have been produced from plant material grown in the USA are classified in the same manner as other confiscated samples, with additional designation as being domestically produced.

Analysis

Marijuana—All samples that were primarily classified as cannabis plant material were extracted according to the procedure previously described (19). Briefly, the samples were manicured in a 12 mesh (0.0555 in. opening) metal sieve to remove seeds and stems. Duplicate 0.1 g samples were each extracted with 3 mL of internal standard/extracting solution (100 mg of 4-androstene-3,17-dione + 10 mL chloroform + 90 mL methanol) at room temperature for 1 h. The extracts were withdrawn into disposable transfer pipettes through cotton plugs for filtration and placed in screw-capped vials. Portions of these extracts are transferred into GC vials which are then capped and placed on the autosampler. One μL aliquots were injected.

Hashish—Samples were first prepared by grinding to a fine powder using a mortar and pestle or an electric blender. Duplicate 0.1 g samples were then extracted following the procedure outlined for marijuana samples.

Hash Oil—Duplicate 0.1 g samples were each mixed with 4 mL of internal standard solution (50 mg of 4-androstene-3,17-dione + 50 mL absolute ethanol) and allowed to stand under the hood for 2–4 h. The samples were sonicated for about 5 min, then 20 mL of absolute ethanol were added to each sample and sonicated again. Each extract was transferred into a vial. One μL aliquots of the extracts were injected into the GC.

Some hashish and hash oil samples have exhibited the unusual property of being insoluble in organic solvents, but soluble in water. These samples were prepared by partitioning a 0.1 g portion between 10 mL each of chloroform and water in a separatory funnel. After three extractions with chloroform, the extracts were combined, dried over anhydrous sodium sulfate, evaporated to dryness and the residue dissolved in 1 mL of ethanolic solution containing the internal standard. One μL aliquots of the final solution were injected into the GC.

Chromatographic Analysis

Gas chromatography (GC) analyses were performed using Hewlett-Packard 5880A gas chromatograph (Hewlett-Packard, Palo Alto, CA) equipped with a Hewlett-Packard 7673 automatic liquid sampler, a capillary injector (with Merlin Microseal) and dual flame ionization detectors. The column was a 15 m × 0.25 mm DB-1, 0.25 μ film (J&W Scientific, Inc.). Data are recorded using a Hewlett-Packard 5880A series GC terminal. Helium is used as the carrier gas. An indicating moisture trap and an indicating oxygen trap located in the helium line from upstream to downstream, respectively, were used. Helium was used as the "make-up" gas at the detector. Hydrogen and compressed air were used as the combustion gases.

The following are the instrument parameters used for monitoring samples; Air—30 psi (400 mL/min); Hydrogen—30 psi (30 mL/min); column head pressure—8 psi (1.0 mL/min); split flow rate—50 mL/min; split ratio—50:1; septum purge flow rate: 5 mL/min; make up gas pressure—20 psi (20 mL/min); injector temp: 240°C; detector temp: 260°C; initial oven temp: 170°C; initial temp. hold time: 1 min; temp. rate: 10°C/min; final oven temp: 250°C; final temp. hold time: 3 min; attenuation: 2; chart speed: 1.00 cm/min; threshold: 2; peak width: 0.04 min; offset: 10%; run time: 12 min; integration ON time: 3 min. The instruments were calibrated each time columns were changed and routinely checked for compliance with the calibration response factor for Δ^9-THC relative to internal standard which was found to be 1.

Results and Discussion

During the last eighteen years (1980–1997), a total of 35,213 samples of confiscated cannabis preparations representing over 7717 tons seized in the USA, have been analyzed for this report. Table 1 shows the total number of samples analyzed each year and the breakdown of the different types of samples as cannabis (ditchweed, marijuana, sinsemilla, and Thai sticks), hashish and hash oil and their relative preponderance. The classification of samples is carried out by the submitting agency and then verified by the laboratory upon receipt of the samples. Prior to 1995, there was no classification in the database for ditchweed and, therefore, all ditchweed samples were classified as marijuana. However, because of the interest in monitoring this type of sample and its effect on the overall potency of confiscated marijuana, the classification of ditchweed was added to the sample report form in 1995. The data presented in this report on ditchweed prior to 1995 was, therefore, generated by retrospective review of the analytical data. Any marijuana samples containing less than 1% Δ^9-THC and having a CBD level greater than its Δ^9-THC level was classified as ditchweed. It is evident from Table 1 that cannabis represents the overwhelming majority of the samples confiscated in the USA with hash oil representing less than 1% of the samples over the last ten years and hashish representing less than 5% of the samples over the last 15 years and less than 1% over the last four years. Among the cannabis samples, marijuana represents approximately 85–90% of the samples. The percentage of samples that were ditchweed varies, typically from 3–6% with occasional levels of up to 11% in some years. The percentage of samples that were sinsemilla also fluctuated between 3–6% of the samples while Thai sticks represented an insignificant portion of the samples analyzed and were totally absent after 1990.

Table 2 shows the average Δ^9-THC concentration by sample type and year seized. There does not appear to be any meaningful trends with respect to the average potency for hashish and hash oil. The yearly average Δ^9-THC concentration of hashish samples has varied over a wide range (2.52 to 19.24%). The average potency of hash oil samples has also varied considerably ranging from a low of 8.52% in 1988 to a high of 21.36% in 1983.

Examination of Table 2 relative to all cannabis samples shows that on the average, the potency rose from 1980 to 1984 reaching an average Δ^9-THC concentration of 3.29%. Slight fluctuations in the average potency were observed for the period between 1984 and 1990. Starting in 1991, there has been a gradual increase in the average potency from a Δ^9-THC concentration of 3.00% in 1991 to 4.47% in 1997 (approximately 50% increase).

TABLE 1—*Number of samples analyzed by type of sample and year seized.*

		Type of sample											
		Cannabis											
		Type of Cannabis Sample											
	All Samples	Ditchweed		Marijuana		Sinsemilla		Thai Sticks		Hashish		Hash Oil	
	n	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
1980	198	6	3.03	120	60.61	26	13.13	1	.51	37	18.69	8	4.04
1981	278	20	7.19	209	75.18	31	11.15	0	.00	13	4.68	5	1.80
1982	527	30	5.69	435	82.54	14	2.66	8	1.52	32	6.07	8	1.52
1983	1,306	60	4.59	1,145	87.67	17	1.30	7	.54	47	3.60	30	2.30
1984	1,211	50	4.13	1,030	85.05	36	2.97	3	.25	59	4.87	33	2.73
1985	1,679	111	6.61	1,449	86.30	52	3.10	1	.06	41	2.44	25	1.49
1986	1,631	147	9.01	1,370	84.00	32	1.96	6	.37	53	3.25	23	1.41
1987	1,784	103	5.77	1,550	86.88	43	2.41	3	.17	63	3.53	22	1.23
1988	1,881	82	4.36	1,640	87.19	98	5.21	2	.11	43	2.29	16	.85
1989	1,300	111	8.54	1,075	82.69	86	6.62	0	.00	19	1.46	9	.69
1990	1,313	93	7.08	1,108	84.39	61	4.65	1	.08	38	2.89	12	.91
1991	2,547	283	11.11	2,148	84.33	75	2.94	0	.00	31	1.22	10	.39
1992	3,623	128	3.53	3,336	92.08	76	2.10	0	.00	61	1.68	22	.61
1993	3,410	200	5.87	3,031	88.89	123	3.61	0	.00	39	1.14	17	.50
1994	3,318	147	4.43	3,024	91.14	104	3.13	0	.00	29	.87	14	.42
1995	4,788	163	3.40	4,429	92.50	164	3.43	0	.00	19	.40	13	.27
1996	2,443	117	4.79	2,138	87.52	168	6.88	0	.00	12	.49	8	.33
1997	1,976	55	2.78	1,805	91.35	111	5.62	0	.00	5	.25	0	.00

TABLE 2—*Average THC level by type of sample and year seized.*

	Type of Sample						
	Cannabis						
	Type of Cannabis Sample					Hashish	Hash Oil
	Ditchweed, %	Marijuana, %	Sinsemilla, %	Thai Sticks, %	All Samples, %	All Samples, %	All Samples, %
1980	.26	1.24	6.33	.05	2.06	2.58	16.56
1981	.32	1.83	6.58	–	2.28	2.91	17.45
1982	.44	3.07	7.10	4.60	3.05	2.69	19.88
1983	.45	3.30	7.87	4.17	3.23	5.47	21.36
1984	.42	3.31	6.67	5.71	3.29	5.75	16.75
1985	.48	2.83	7.28	6.26	2.82	6.49	15.08
1986	.31	2.36	8.43	4.23	2.30	2.66	16.51
1987	.34	2.96	7.93	4.45	2.93	2.62	13.36
1988	.39	3.18	7.62	3.37	3.29	3.35	8.52
1989	.29	3.04	6.95	–	3.06	7.06	11.96
1990	.33	3.24	10.10	.12	3.35	5.30	16.60
1991	.31	3.09	10.53	–	3.00	5.21	13.07
1992	.31	3.08	8.57	–	3.10	5.35	13.85
1993	.37	3.38	5.77	–	3.29	6.60	16.52
1994	.38	3.50	7.49	–	3.48	4.60	11.57
1995	.41	3.73	7.51	–	3.75	3.60	13.23
1996	.38	3.87	9.22	–	4.07	2.52	12.82
1997	.48	4.15	11.53	–	4.47	19.24	–

Table 2 also shows the average Δ^9-THC concentration for the different types of cannabis samples. As would be expected, very little fluctuation is seen in the average potency of ditchweed samples. With average concentrations only varying from a low of 0.26% in 1980 to a high of 0.48% in 1985 and 1997.

The average potency of the marijuana samples follows a pattern similar to the one described above for all cannabis samples. During the period of 1980 to 1984, the average potency increased each year. This appeared to level off and actually dropped during some years for the period of 1985 to 1991. However, since 1992, there appears to have been a slow, yet steady, increase in the average Δ^9-THC concentrations for marijuana samples. Figure 1 shows a graphical representation of the mean potency for marijuana samples over the years with the 95% confidence intervals for each year.

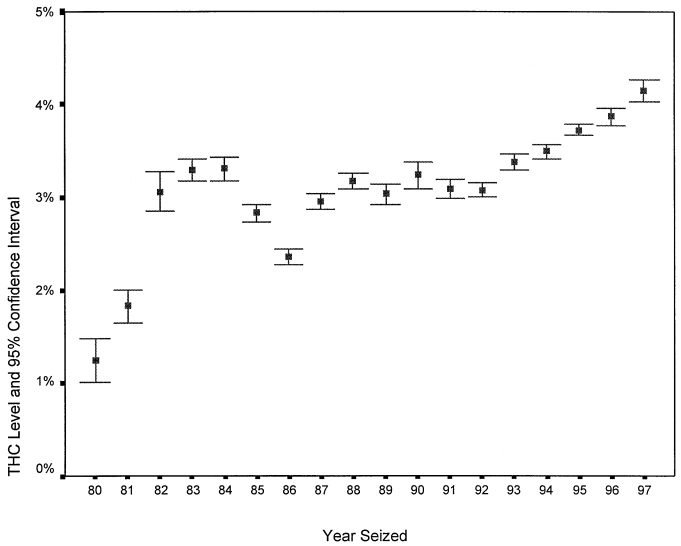

FIG. 1—*Mean THC level and 95% confidence intervals for marijuana samples by year of seizure.*

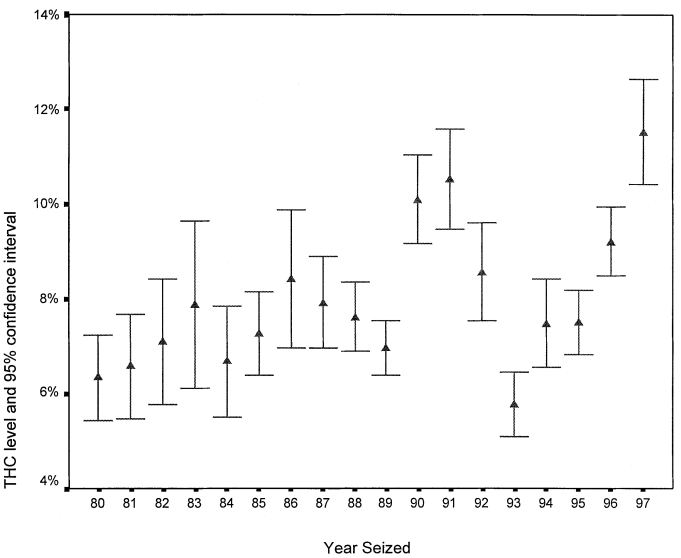

FIG. 2—*Mean THC level and 95% confidence intervals for sinsemilla samples by year of seizure.*

This graph clearly shows the trend that has occurred during the last five years and how the average potency of marijuana samples has risen significantly almost every one of the last five years.

On the other hand, the average Δ^9-THC concentration for sinsemilla has fluctuated considerably, ranging from a low of 5.77% in 1993 to a high of 11.53% in 1997. Other than the expected finding that the average potency for sinsemilla samples was much higher than that for marijuana samples, there does not appear to be any meaningful trend across time in the average potency of the sinsemilla samples analyzed. This is clearly shown in Fig. 2 which represents the mean potency for sinsemilla samples each year with the 95% confidence intervals. One thing to note is the greater variability in potency for sinsemilla samples within each year that is illustrated by larger confidence intervals than those seen in Fig. 1.

TABLE 3—*Number and percent of outlier samples by year seized.*

	Type of Sample							
	Marijuana				Sinsemilla			
	z-score $<\pm 2.5$		Hi Outlier		*z*-score $<\pm 2.5$		Hi Outlier	
	N	%	*N*	%	*N*	%	*N*	%
1980	117	97.5	3	2.5	26	100.0	0	.0
1981	203	97.1	6	2.9	31	100.0	0	.0
1982	423	97.2	12	2.8	14	100.0	0	.0
1983	1123	98.1	22	1.9	17	100.0	0	.0
1984	1009	98.0	21	2.0	36	100.0	0	.0
1985	1417	97.8	32	2.2	51	98.1	1	1.9
1986	1334	97.4	36	2.6	31	96.9	1	3.1
1987	1522	98.2	28	1.8	42	97.7	1	2.3
1988	1610	98.2	30	1.8	96	98.0	2	2.0
1989	1052	97.9	23	2.1	84	97.7	2	2.3
1990	1076	97.1	32	2.9	60	98.4	1	1.6
1991	2087	97.2	61	2.8	75	100.0	0	.0
1992	3261	97.8	75	2.2	76	100.0	0	.0
1993	2943	97.1	88	2.9	120	97.6	3	2.4
1994	2954	97.7	70	2.3	102	98.1	2	1.9
1995	4343	98.1	86	1.9	162	98.8	2	1.2
1996	2090	97.8	48	2.2	165	98.2	3	1.8
1997	1747	96.8	58	3.2	110	99.1	1	.9

NOTE: Outlier defined as a *z*-score of ± 2.5 or more with *z*-scores computed separately for each year.

The change in the potency of marijuana over the years has been the subject of controversy. This report is intended to clarify this issue. One of the shortcomings of the previous reports (16,17) was the lack of statistical analysis of the data and the possible exclusion of outliers. In this report, attempts were made to determine the influence of outlier samples on the overall average concentration of Δ^9-THC for the time period studied.

Table 3 shows the number and percent of samples with a *Z* score of $<\pm 2.5$ and those outside of that range (outliers) for both marijuana and sinsemilla samples from 1980–1997. In both types of samples in all years, the number of outliers represented less than 3% of the total samples analyzed, except 1997 for marijuana (3.2%) and 1986 for sinsemilla (3.1%). It should be noted from Table 3 that the distribution of Δ^9-THC concentrations is positively skewed such that outliers only occur on the high side for each year. Since the only outliers are samples with high THC concentrations and the potential for variability is much greater on the high side of the mean, it is important that the potential effect of these outliers is examined closely in order to determine whether the apparent trend of increasing potency is real or simply a statistical artifact. Table 4 shows a comparison of the average potency of marijuana and sinsemilla samples calculated for all samples versus for samples with outliers excluded. As would be expected, the mean Δ^9-THC concentration drops somewhat for each year when the outliers are excluded (Table 4). However, the general pattern of increasing potency of marijuana samples since 1992 appears to exist even when high outliers are excluded. Because of the greater variability found in the potency of sinsemilla samples, fewer cases were excluded as outliers and thus there was little effect on the average potency for each of the years reported.

Further evidence that the mean Δ^9-THC concentration for marijuana may actually be increasing is shown in Table 5. Table 5 shows the number and percent of samples each year that had a Δ^9-THC concentration greater than 3, 5, and 9%. Since 1992, the per-

TABLE 4—*Average concentrations of THC found in marijuana and sinsemilla samples for all samples and when outliers* are excluded.*

	Type of Sample							
	Marijuana				Sinsemilla			
	All Samples		Outliers Excluded*		All Samples		Outliers Excluded*	
	No. of Samples	Mean THC	No. of Samples	Mean THC	No. of Samples	Mean THC	No. of Samples	Mean THC
1980	120	1.24%	117	1.10%	26	6.33%	26	6.33%
1981	209	1.83%	203	1.71%	31	6.58%	31	6.58%
1982	435	3.07%	423	2.88%	14	7.10%	14	7.10%
1983	1145	3.30%	1123	3.17%	17	7.87%	17	7.87%
1984	1030	3.31%	1009	3.16%	36	6.67%	36	6.67%
1985	1449	2.83%	1417	2.70%	52	7.28%	51	7.12%
1986	1370	2.36%	1334	2.21%	32	8.43%	31	8.10%
1987	1550	2.96%	1522	2.85%	43	7.93%	42	7.70%
1988	1640	3.18%	1610	3.06%	98	7.62%	96	7.42%
1989	1075	3.04%	1052	2.92%	86	6.95%	84	6.77%
1990	1108	3.24%	1076	2.99%	61	10.10%	60	9.95%
1991	2148	3.09%	2087	2.83%	75	10.53%	75	10.53%
1992	3336	3.08%	3261	2.84%	76	8.57%	76	8.57%
1993	3031	3.38%	2943	3.09%	123	5.77%	120	5.52%
1994	3024	3.50%	2954	3.32%	104	7.49%	102	7.15%
1995	4429	3.73%	4343	3.59%	164	7.51%	162	7.34%
1996	2138	3.87%	2090	3.68%	168	9.22%	165	8.98%
1997	1805	4.15%	1747	3.86%	111	11.53%	110	11.33%

* Outliers are samples with *z*-scores of ±2.5 or more.

TABLE 5—*Number and percent of samples containing 3, 5, and 9 percent THC by year seized.*

	Type of Sample												
	Marijuana							Sinsemilla					
	High Samples							High Samples					
	No. of Samples	>3% THC		>5% THC		>9% THC		No. of Samples	>3% THC		>5% THC		>9% THC	
		n	%	*n*	%	*n*	%		*n*	%	*n*	%	*n*	%
1980	120	9	7.5	2	1.7	0	.0	26	23	88.5	19	73.1	3	11.5
1981	209	35	16.7	6	2.9	0	.0	31	29	93.5	21	67.7	6	19.4
1982	435	188	43.2	75	17.2	5	1.1	14	13	92.9	12	85.7	3	21.4
1983	1145	544	47.5	217	19.0	13	1.1	17	17	100.0	12	70.6	6	35.3
1984	1030	527	51.2	166	16.1	13	1.3	36	35	97.2	20	55.6	10	27.8
1985	1449	565	39.0	158	10.9	10	.7	52	48	92.3	40	76.9	14	26.9
1986	1370	374	27.3	86	6.3	8	.6	32	31	96.9	23	71.9	14	43.8
1987	1550	684	44.1	176	11.4	9	.6	43	43	100.0	37	86.0	12	27.9
1988	1640	836	51.0	242	14.8	9	.5	98	93	94.9	71	72.4	29	29.6
1989	1075	515	47.9	139	12.9	6	.6	86	84	97.7	62	72.1	17	19.8
1990	1108	522	47.1	176	15.9	32	2.9	61	60	98.4	58	95.1	33	54.1
1991	2148	914	42.6	280	13.0	57	2.7	75	68	90.7	63	84.0	47	62.7
1992	3336	1334	40.0	393	11.8	73	2.2	76	68	89.5	57	75.0	33	43.4
1993	3031	1481	48.9	448	14.8	98	3.2	123	88	71.5	59	48.0	26	21.1
1994	3024	1663	55.0	544	18.0	63	2.1	104	79	76.0	65	62.5	41	39.4
1995	4429	2842	64.2	786	17.7	63	1.4	164	142	86.6	108	65.9	56	34.1
1996	2138	1343	62.8	523	24.5	53	2.5	168	156	92.9	129	76.8	82	48.8
1997	1805	1141	63.2	518	28.7	105	5.8	111	106	95.5	94	84.7	71	64.0

centage of marijuana samples having a Δ^9-THC concentration greater than 5% has increased from 11.8% of samples to 28.7% of samples. Considering the large number of marijuana samples analyzed each year, it is doubtful that this is a statistical artifact.

Table 6 shows the overall average concentration of Δ^9-THC in the different types of samples analyzed for this report with the lowest and highest (range) levels observed. The table also shows the same data for those samples of known domestic origin and those non-domestic samples. It must be mentioned that samples are classified as being of domestic origin only if the seizure is made from a growing operation (indoor or outdoor) within the USA. All other samples are classified as being non-domestic, although they could have possibly been produced in the USA prior to seizure. It is evident that ditchweed and sinsemilla are mainly domestic products

TABLE 6—*Average, maximum, and minimum THC levels by type of sample*.

				THC			
				No. of Samples	Mean	Highest	Lowest
Origin	Domestic	Cannabis	Ditchweed	1,693	.37%	2.40%	.01%
			Marijuana	9,771	2.62%	26.16%	.00%
			Sinsemilla	1,027	8.05%	33.12%	.10%
		Hashish		5	12.86%	52.87%	1.01%
		Hash oil		5	17.41%	31.65%	.21%
	Non-domestic	Cannabis	Ditchweed	213	.34%	.99%	.01%
			Marijuana	21,274	3.65%	29.86%	.01%
			Sinsemilla	295	8.75%	22.48%	.77%
			Thai sticks	32	4.22%	8.92%	.05%
		Hashish		636	4.52%	28.23%	.01%
		Hash oil		270	15.30%	47.01%	.04%
All Samples		Cannabis	Ditchweed	1,906	.36%	2.40%	.01%
			Marijuana	31,045	3.32%	29.86%	.00%
			Sinsemilla	1,322	8.20%	33.12%	.10%
			Thai sticks	32	4.22%	8.92%	.05%
		Hashish		641	4.59%	52.87%	.01%
		Hash oil		275	15.34%	47.01%	.04%

TABLE 7—*Average concentrations of four cannabinoids found in illicit cannabis samples*.

	Type of Sample													
	Ditchweed					Marijuana					Sinsemilla				
	No. of Seizures	THC, %	CBD, %	CBC, %	CBN, %	No. of Seizures	THO, %	CBD, %	CBC, %	CBN, %	No. of Seizures	THC, %	CBD, %	CBC, %	CBN, %
1980	6	.26	1.01	.03	.06	120	1.24	.01	.13	.57	26	6.33	.32	.23	.14
1981	20	.32	2.26	.06	.02	209	1.83	.14	.16	.45	31	6.58	.49	.22	.14
1982	30	.44	1.72	.04	.11	435	3.07	.25	.19	.35	14	7.10	.31	.29	.19
1983	60	.45	1.17	.00	.06	1145	3.30	.16	.17	.31	17	7.87	.82	.18	.28
1984	50	.42	1.79	.00	.11	1030	3.31	.17	.17	.35	36	6.67	.26	.24	.36
1985	111	.48	1.34	.03	.04	1449	2.83	.19	.15	.24	52	7.28	.43	.27	.38
1986	147	.31	1.67	.03	.08	1370	2.36	.15	.16	.22	32	8.43	.09	.26	.41
1987	103	.34	2.11	.04	.10	1550	2.96	.17	.18	.31	43	7.93	.40	.23	.35
1988	82	.39	1.69	.03	.13	1640	3.18	.20	.15	.31	98	7.62	.55	.20	.35
1989	111	.29	1.54	.10	.04	1075	3.04	.25	.14	.24	86	6.95	.37	.20	.19
1990	93	.33	2.29	.11	.02	1108	3.24	.23	.18	.21	61	10.10	.25	.24	.14
1991	283	.31	2.09	.07	.02	2148	3.09	.23	.20	.18	75	10.53	.45	.26	.20
1992	128	.31	1.76	.07	.00	3336	3.08	.18	.20	.38	76	8.57	.42	.24	.17
1993	200	.37	1.66	.07	.01	3031	3.38	.27	.20	.30	123	5.77	.91	.25	.14
1994	147	.38	1.97	.15	.59	3024	3.50	.46	.22	.32	104	7.49	1.20	.25	.12
1995	163	.41	1.56	.11	.19	4429	3.73	.37	.20	.38	164	7.51	.96	.28	.12
1996	117	.38	2.11	.12	1.77	2138	3.87	.49	.24	.36	168	9.22	1.19	.34	.19
1997	55	.48	2.05	.15	.05	1805	4.15	.61	.27	.24	111	11.53	.86	.29	.13

TABLE 8—*Average concentrations of four cannabinoids found in Hash samples*.

	Type of Sample									
	Hashish					Hash Oil				
	No. of Seizures	THC, %	CBD, %	CBC, %	CBN, %	No. of Seizures	THC, %	CBD, %	CBC, %	CBN, %
1980	37	2.58	7.58	.38	1.88	8	16.56	8.67	1.02	5.31
1981	13	2.91	6.51	.28	1.91	5	17.45	10.16	1.35	3.63
1982	32	2.69	6.73	.10	1.45	8	19.88	8.28	1.58	4.34
1983	47	5.47	6.15	.13	1.62	30	21.36	3.25	1.47	4.57
1984	59	5.75	3.25	.31	1.59	33	16.75	1.36	1.06	4.31
1985	41	6.49	2.30	.34	1.33	25	15.08	.42	.96	5.08
1986	53	2.66	1.10	.30	1.27	23	16.51	2.10	1.52	3.18
1987	63	2.62	1.63	.19	1.24	22	13.36	.29	.99	3.95
1988	43	3.35	2.22	.21	1.70	16	8.52	1.46	.65	2.22
1989	19	7.06	5.08	.32	1.56	9	11.96	1.59	.85	4.85
1990	38	5.30	4.90	.43	1.50	12	16.60	.86	.74	1.81
1991	31	5.21	3.58	.50	1.78	10	13.07	3.26	.95	2.25
1992	61	5.35	2.97	.62	3.20	22	13.85	1.05	1.35	4.19
1993	39	6.60	4.34	.70	2.32	17	16.52	.13	.88	8.20
1994	29	4.60	3.53	.49	1.71	14	11.57	.42	.90	3.08
1995	19	3.60	3.34	.51	1.70	13	13.23	1.34	1.18	5.01
1996	12	2.52	4.53	.70	2.43	8	12.82	1.70	1.25	3.99
1997	5	19.24	5.43	.66	1.44	0				

and that Thai sticks, hashish, and hash oil are non-domestic products. Overall, the number of domestic samples represent approximately 30% of all samples confiscated.

In addition to monitoring the Δ^9-THC in confiscated samples, analysis of other cannabinoids was also carried out. Table 7 shows the average concentration of CBD, CBC and CBN in addition to Δ^9-THC in the different types of cannabis samples while Table 8 shows the same information for hashish and hash oil. CBD is the major cannabinoid found in fiber type cannabis (ditchweed) and is of significant proportion in intermediate type cannabis usually used to make hashish (Table 8). CBC, on the other hand, although it is not the predominant cannabinoid in any samples, is usually higher in drug type cannabis while most fiber type samples contain very little CBC, if any. CBN is the oxidation (dehydrogenating) product of Δ^9-THC and its relative concentration to Δ^9-THC reflects the age of the samples (18).

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