

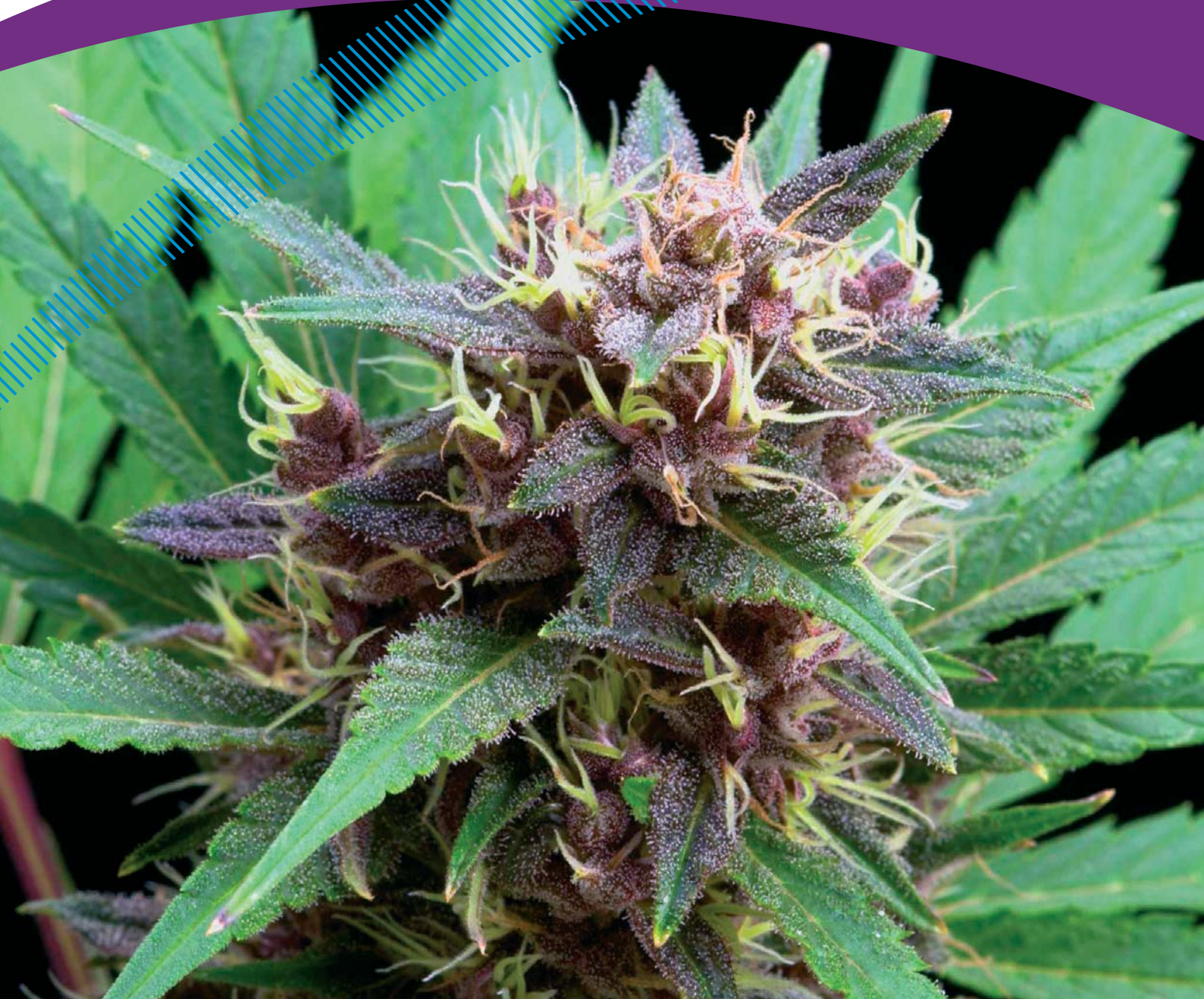
# HOME OFFICE CANNABIS POTENCY STUDY 2008



Home Office

Scientific  
Development Branch

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# ACKNOWLEDGEMENTS

The success of this project was only possible due to the enthusiasm and commitment of a large number of people. Thanks are due to David Potter, GW Pharmaceuticals Ltd. for providing photographs and useful discussions; Simon Byrne, Assistant Chief Constable Merseyside Police who gave such a positive lead from the Association of Chief Police Officers (ACPO) Drugs Committee to the forces; the members of the ACPO Drugs Committee Standing Working Group who engaged so enthusiastically to stimulate their forces and to the unknown officers and civilian staff who actually made it happen.

We also want to thank the staff at the two forensic laboratories that worked together so willingly to establish the methodology and then managed to dovetail this project into their normal casework.

Cover photograph Courtesy David Potter,  
GW Pharmaceuticals Ltd.

# EXECUTIVE SUMMARY

- This study was funded by the Home Office. It arose from a recommendation in the 2006 Cannabis report of the Advisory Council on the Misuse of Drugs (ACMD).
- The proportion of herbal cannabis has increased markedly in recent years. In 2002 it was estimated that it represented around 30% of police seizures of cannabis, but by 2004/5 had reached 55%.
- Twenty-three Police Forces in England and Wales participated in the study. Forces were requested to submit samples confiscated from street-level users. In early 2008, they submitted 2,921 samples for analysis to either the Forensic Science Service Ltd (FSS) or LGC Forensics at Culham (LGC F).
- Initial laboratory examination showed that 80.8% were herbal cannabis and 15.3% were cannabis resin. The remaining 3.9% were either indeterminate or not cannabis.
- Microscopic examination of around two-thirds of the samples showed that over 97% of the herbal cannabis had been grown by intensive methods (sinsemilla). The remainder was classed as traditional imported herbal cannabis.
- Regional variations were found in the market share of herbal cannabis. Thus North Wales, South Wales, Cleveland and Devon and Cornwall submitted proportionately fewer herbal cannabis samples, whereas Essex, Metropolitan and Avon and Somerset submitted proportionately more. These differences were statistically significant at the 0.1% confidence interval.
- The mean THC concentration (potency) of the sinsemilla samples was 16.2% (range = 4.1 to 46%). The median potency was 15.0%, close to values reported by others in the past few years.
- The mean THC concentration (potency) of the traditional imported herbal cannabis samples was 8.4% (range = 0.3 to 22%); median = 9.0%. Only a very small number of samples were received and analysed.
- The mean potency of cannabis resin was 5.9% (range = 1.3 to 27.8%). The median = 5.0% was typical of values reported by others over many years.
- Cannabis resin had a mean CBD content of 3.5% (range = 0.1 to 7.3%), but the CBD content of herbal cannabis was less than 0.1% in nearly all cases.
- There was a weak, but statistically-significant, correlation ( $r = 0.48$ ;  $N = 112$ ;  $P < 0.001$ ) between the THC and the CBD content of resin.



# INTRODUCTION

Herbal cannabis and cannabis resin are the most widely-misused illicit substances in the UK. For many years, herbal cannabis was imported into the UK from the Caribbean, West Africa and Asia. It is often seen in the form of compressed brown vegetable matter containing seeds and stalks (Figure 1). Domestic production of intensively-cultivated herbal cannabis started in around 1990. It has been grown indoors from selected seed varieties and propagation of female plant cuttings using artificial lighting, heating, and control of day-length. This material is known as sinsemilla (without seeds; Figure 2). It consists mostly of the flowering tops of female plants, and is easily distinguished from the imported material. Cannabis resin (Figure 3) has been imported mostly from North Africa. The potency of cannabis is defined as the concentration (%) of  $\Delta^9$ -tetrahydrocannabinol (THC), the major active principle of the cannabis plant. Apart from THC, cannabis and cannabis resin contain many other so-called cannabinoids. One of these (cannabidiol, CBD) has attracted recent interest because it is believed to show anti-psychotic properties.

In 2006, the Advisory Council on the Misuse of Drugs (ACMD) reviewed the classification of cannabis (Reference 1). One of the recommendations was that a further study should be carried out to determine the market share of different types of cannabis and their potencies. In view of current scientific interest in the role of CBD, it was decided that this should also be measured.

The Home Office funded the project. This included paying the forensic providers to establish the methodology using internal THC and CBD standards and to exchange samples for the comparison and harmonisation of the method for the determination of THC and CBD concentrations. The numbers of samples examined was then limited by the funds available.

# METHODS

In late 2007, police forces in England and Wales were invited to participate in a cannabis study. For administrative reasons, forces in Scotland and Northern Ireland were not involved. Police were requested to submit samples of cannabis confiscated from street-level users when issuing a warning and submit them to their usual service provider for laboratory examination. Samples from the Metropolitan Police were sent to both FSS and LGC Forensics. These samples were separate from those sent to laboratories for evidential purposes. There was no cost to the forces except the effort of administering the exercise.

On receipt at the laboratories, samples were weighed and visually examined by experts to determine if they were herbal cannabis, cannabis resin or something else (e.g. mixture, pipe, grinder, white powder). Also at this stage, many samples were identified as being too small for full analysis. A random selection of herbal cannabis samples was then submitted for more detailed microscopic examination to distinguish sinsemilla from traditional imported cannabis.

Herbal cannabis is a non-homogeneous product. The active constituents are produced by secretions of glandular trichomes, most of which are situated on the bracts of the female flowers. For this reason, leaves and stalk contain little THC. Although cannabis resin is more homogeneous, atmospheric oxidation of THC causes the concentration of THC to be lower in the outer surface of a resin block than in the middle. Because the samples were small, it was agreed that the whole would be used for quantitative analysis to avoid errors caused by sample inhomogeneity.

Of the resin, sinsemilla and traditional imported samples, further random samples were examined to determine the THC and CBD content. The two laboratories used a similar analytical procedure that incorporated shared cannabis reference standards to ensure consistency. The homogenised samples were extracted with ethanol containing the internal standard androstenedione. The concentrations of total THC (THC and THC acid) and CBD were determined using either gas-chromatography or gas-chromatography coupled to mass-spectrometry with THC and CBD as external standards.

# RESULTS

Twenty-three Police Forces in England and Wales participated in the study. In early 2008, they submitted 2,921 samples for analysis to either the Forensic Science Service Ltd (FSS) or LGC Forensics at Culham (LGC F).

The numbers of samples from each force should not be seen as a measure of the 'cannabis problem' in their area. For operational reasons some forces chose to send in material from only one Borough Command Unit or from one of several forces collection points. Some forces experienced internal logistics problems; others were very enthusiastic and sent in everything received during the trial period.

Initial laboratory examination showed that 80.8% were herbal cannabis and 15.3% were cannabis resin. The remaining 3.9% were either indeterminate or not cannabis. The composition of samples for each police force is set out in Table 1; the two laboratories are shown as Lab 1 and Lab 2.

The weight of samples submitted was 4-5g, and typical of what might be termed street-level amounts.

Of the 2,352 samples of herbal cannabis, further examination of around two thirds of the samples showed that over 97% had been grown by intensive methods and were classified as sinsemilla. The remainder were classed as traditional imported herbal cannabis.

Regional variations were found in the market share of herbal cannabis. Thus North Wales, South Wales, Cleveland and Devon and Cornwall submitted proportionately fewer herbal cannabis samples, whereas Essex, Metropolitan and Avon and Somerset submitted proportionately more (Figure 4). These differences were statistically significant (Chi-squared test) at the 0.1% confidence interval. Figure 4 excludes those few samples that could not be classified as either herbal cannabis or cannabis resin on initial examination. Following the second stage of analysis, where herbal cannabis samples were subdivided into those that were or were not sinsemilla, it was found that the proportion of sinsemilla was high in all force areas (Figure 5).

Figure 6 shows the distribution of the potency in the samples examined. The mean THC concentration in sinsemilla samples was 16.2% (range = 4.1 to 46); the median was 15.0%. The mean THC concentration in traditional imported herbal cannabis samples was 8.4% (range = 0.3 to 22%); median = 9.0%. The number of traditional imported herbal cannabis samples received and analysed was small. The mean potency of cannabis resin was 5.9% (range = 1.3 to 27.8), median = 5.0%.

Figure 7 shows the distribution of CBD in cannabis resin. The mean CBD content was 3.5% (range = 0.1 to 7.3), but the CBD content of herbal cannabis was less than 0.1% in nearly all cases.

Figure 8 shows all THC and CBD data plotted as a scatter diagram. There was a weak, but statistically-significant, correlation ( $r = 0.48$ ;  $N = 112$ ;  $P < 0.001$ ) between the THC and the CBD content of resin. It will be seen from Figure 8 that three samples of herbal cannabis had anomalously high CBD values. The reason for this is not understood.

For both sinsemilla and cannabis resin, small differences were found in the median potencies for samples examined by the two laboratories (Table 3). However, these may have arisen from differences in the potency of cannabis in different geographical areas, as reported by Potter et al. (Reference 3). The laboratories had harmonised their methods and exchanged test samples so the results were comparable.

# DISCUSSION

The proportion of herbal cannabis has increased markedly in recent years. In 2002 it was estimated that it represented around 30% of police seizures of cannabis (Reference 2), but by 2004/5 (Reference 3) this had increased to 55%. In the present study, herbal cannabis accounted for over 80% of all cannabis seized by the police on the street when giving a warning. Furthermore, almost all of that material was sinsemilla. There has been a decline in the prevalence of cannabis resin, and traditional imported herbal cannabis is now rarely seen (Table 2). Some sinsemilla is imported from other European countries and some is domestically-produced. This rise in the market share of herbal cannabis over the past six years has also been reported in samples submitted to the FSS (Reference 4) and LGC Forensics (Reference 5) for evidential purposes, although they may be less representative of what is available at street level.

The median potency of sinsemilla in this study (15.0%) was only marginally greater than the median value (13.98%) reported by Potter et al. (Reference 3) for samples collected in 2004/5. Since 1990, when intensively-grown cannabis first appeared in the UK its potency has slowly increased, but this appears to have stabilised. By contrast, the mean/median potency of cannabis resin and imported herbal cannabis has remained largely unchanged over many years (Reference 2). Although the potency of sinsemilla is, on average, 2-3 times that of imported herbal cannabis or cannabis resin, the various populations show considerable overlap (Figure 6).

## REFERENCES

1. Advisory Council on the Misuse of Drugs, Further consideration of the classification of cannabis under the Misuse of Drugs Act 1971, Home Office, London, 2006. Recommendation 7.5 (iii): “...further work to assess the potency of cannabis products currently used by consumers.”
2. L.A. King, C. Carpentier and P. Griffiths, An Overview of Cannabis Potency in Europe, Insights, No. 6, EMCDDA, 2004; L.A.King, C. Carpentier and P. Griffiths, Cannabis Potency in Europe, Addiction, 100, 884-886, 2005
3. D.J. Potter, P. Clark and Marc B. Brown, Potency of  $\Delta^9$ -THC and Other Cannabinoids in Cannabis in England in 2005: Implications for Psychoactivity and Pharmacology, J. Forensic Sci., 53(1), 90-94, 2008
4. M. White, Data presented to ACMD hearings, 5 February 2008
5. A Franc, Written Evidence to ACMD hearings, 5 February 2008
6. A.W. Zuardi, J.A.S. Crippa, J.E.C. Hallak, F.A. Moreira and F.S. Guimarães, Cannabidiol, a Cannabis sativa constituent, as an antipsychotic drug, Brazilian Journal of Medical and Biological Research, 39, 421-429, 2006



# TABLES AND FIGURES

**TABLE 1** SAMPLES SUBMITTED FOR ANALYSIS

Force	Sample size	%	Laboratory	Herbal cannabis	Cannabis resin	Other
Avon and Somerset	355	27.73	Lab2	323	31	1
Bedfordshire	22	1.35	Lab1	22	0	0
Cambridge	160	9.85	Lab1	145	9	6
Cheshire	31	2.34	Lab2	26	5	0
Cleveland	292	17.97	Lab1	148	138	6
Derbyshire	74	4.49	Lab1	62	12	0
Devon and Cornwall	97	7.58	Lab2	60	37	0
Dorset	81	6.33	Lab2	64	17	0
Essex	180	11.08	Lab1	167	4	9
GMP	169	10.40	Lab1	124	20	25
Kent	119	9.30	Lab2	98	18	3
Merseyside	225	13.85	Lab1	180	39	6
Metropolitan	95	5.85	Lab1	76	3	16
Metropolitan	215	16.80	Lab2	190	5	20
North Wales	44	2.71	Lab1	29	15	0
South Wales	52	3.20	Lab1	29	17	6
Staffordshire	29	1.66	Lab1	19	9	1
Suffolk	43	2.65	Lab1	30	10	3
Surrey	212	16.56	Lab2	201	11	0
Sussex	140	10.94	Lab2	114	26	0
Thames Valley	32	2.50	Lab2	30	1	1
Warwickshire	52	3.20	Lab1	43	1	8
West Mercia	123	7.57	Lab1	115	7	1
West Yorkshire	72	4.43	Lab1	57	10	5
<b>Total (*)</b>	<b>2914</b>	<b>100%</b>		<b>2352</b>	<b>445</b>	<b>117</b>
<b>% market share</b>				<b>80.8</b>	<b>15.3</b>	<b>3.9</b>

(\*) The total of 2914 excludes 7 samples that were mixtures of herbal cannabis and cannabis resin.

**TABLE 2** THE MARKET SHARE OF DIFFERENT CANNABIS TYPES (2002 TO 2008)

Year	% Sinsemilla	% Traditional Herbal	% Cannabis Resin
2002 (Reference 2)	15	15	70
2004/5 (Reference 3)	55	45	
2008 (This study)	81	3	16

**TABLE 3** COMPARISON OF THC ANALYSES FOR SINSEMILLA AND CANNABIS RESIN BY TWO LABORATORIES

Laboratory	Sample type	Median %THC	Sample size
FSS	Sinsemilla	16.6	156
LGC F	Sinsemilla	13.3	69
FSS	Resin	4.5	65
LGC F	Resin	5.7	47

**FIGURE 1** TRADITIONAL IMPORTED HERBAL CANNABIS



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**FIGURE 2** SINSEMILLA



Courtesy of David Potter, GW Pharmaceuticals Ltd.



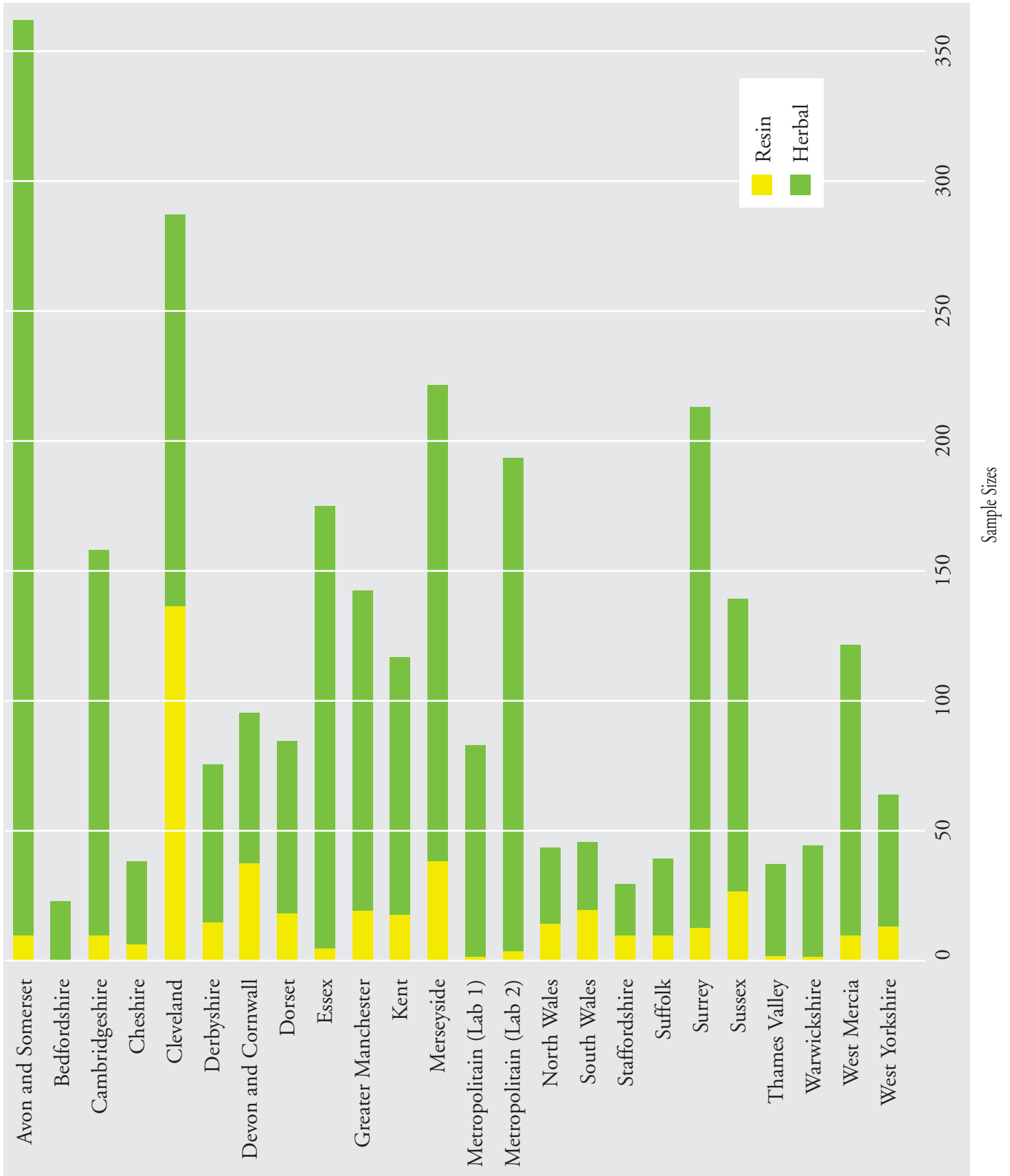
**FIGURE 3** CANNABIS RESIN



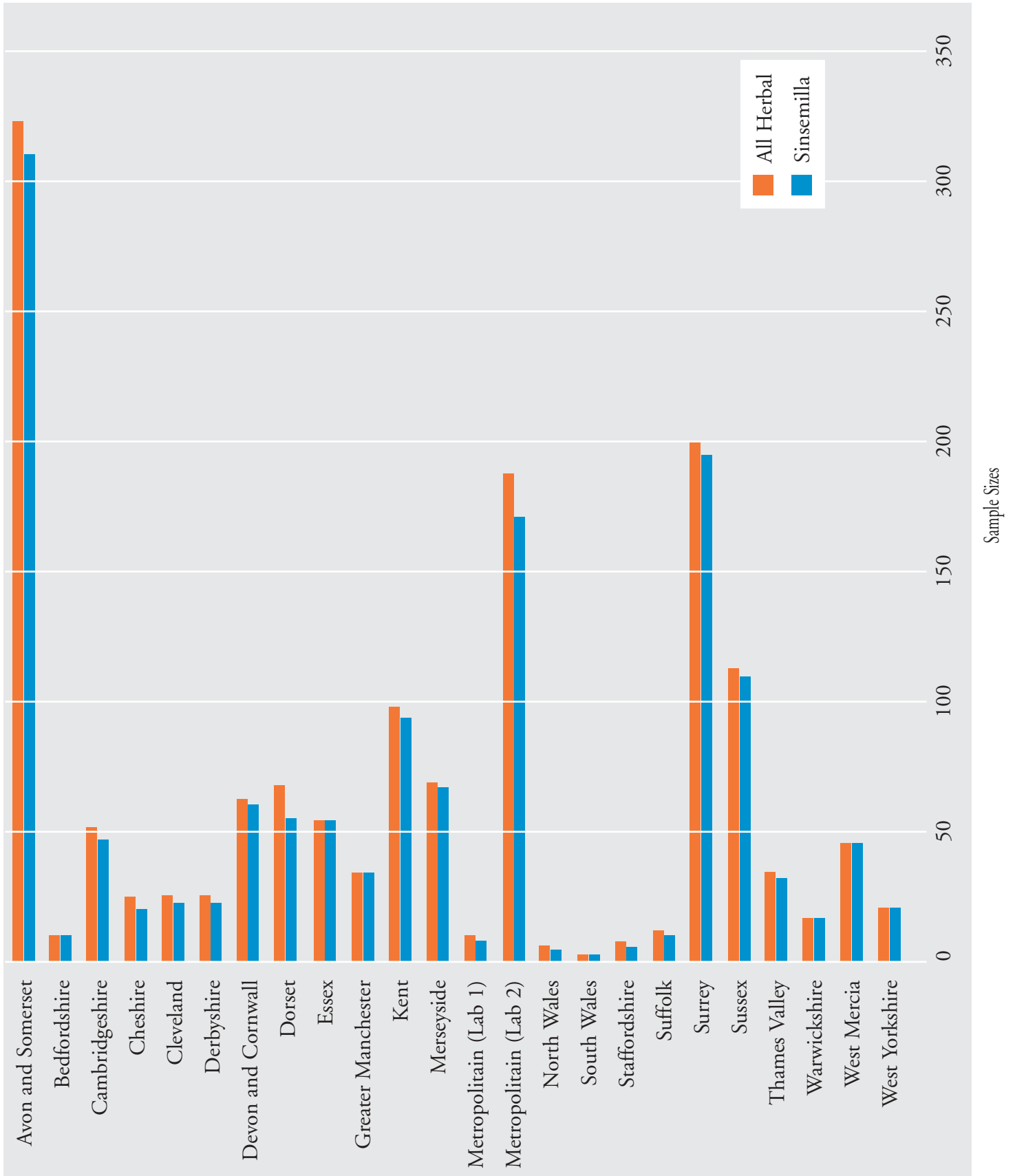
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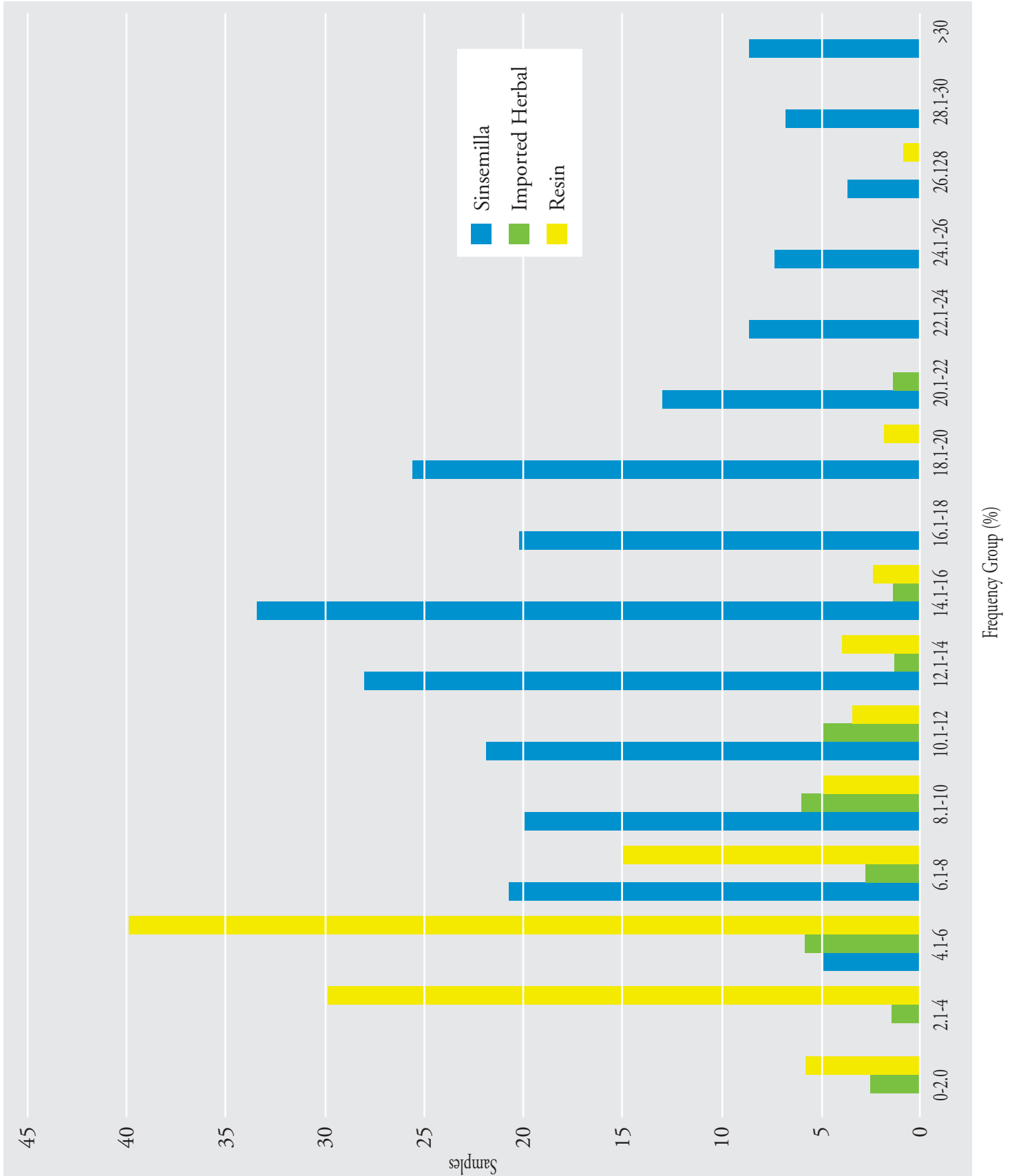
**FIGURE 4** COMPOSITION OF ALL SAMPLES SUBMITTED BY FORCES



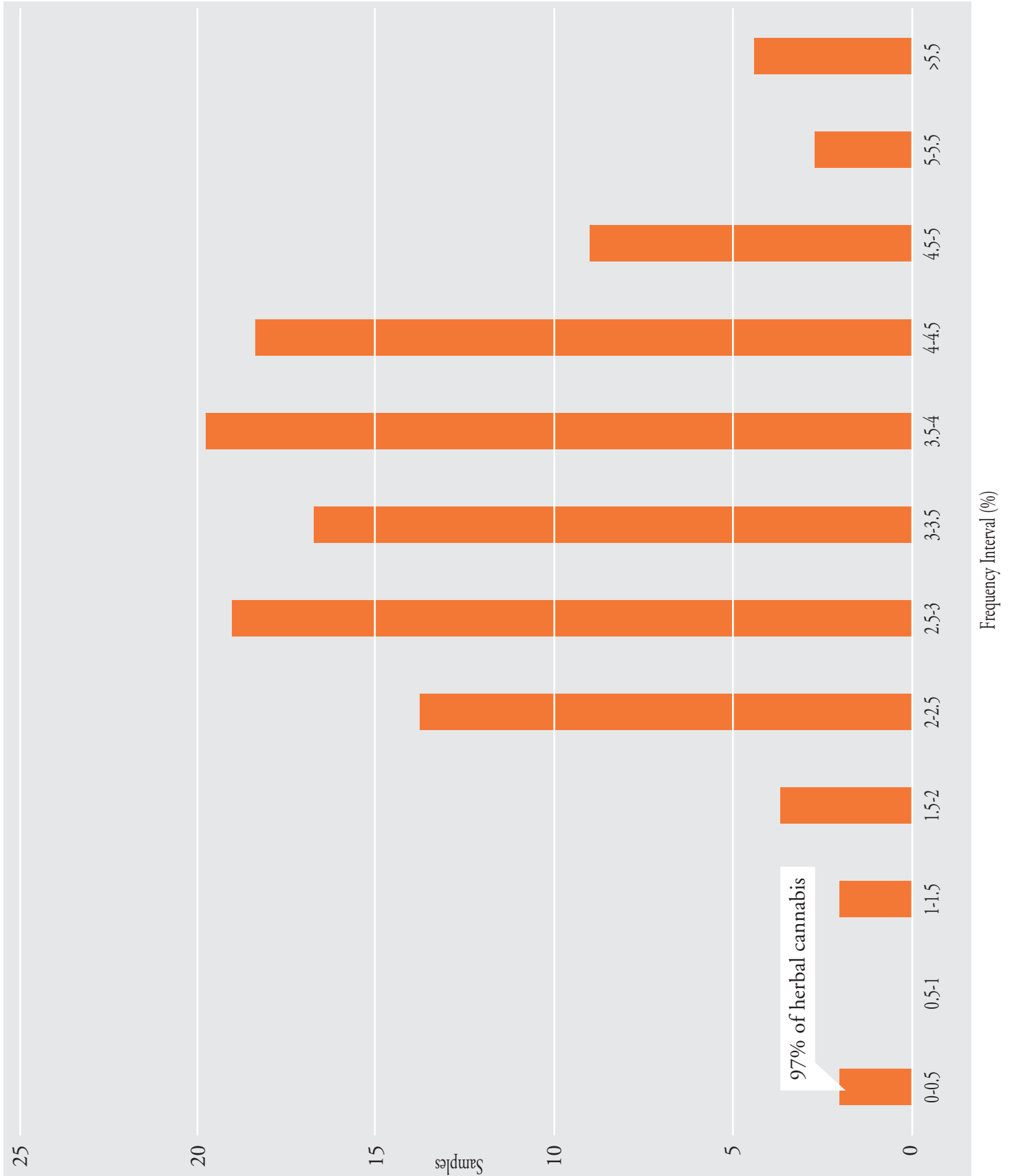
**FIGURE 5** COMPOSITION OF HERBAL CANNABIS SAMPLES SUBMITTED BY FORCES



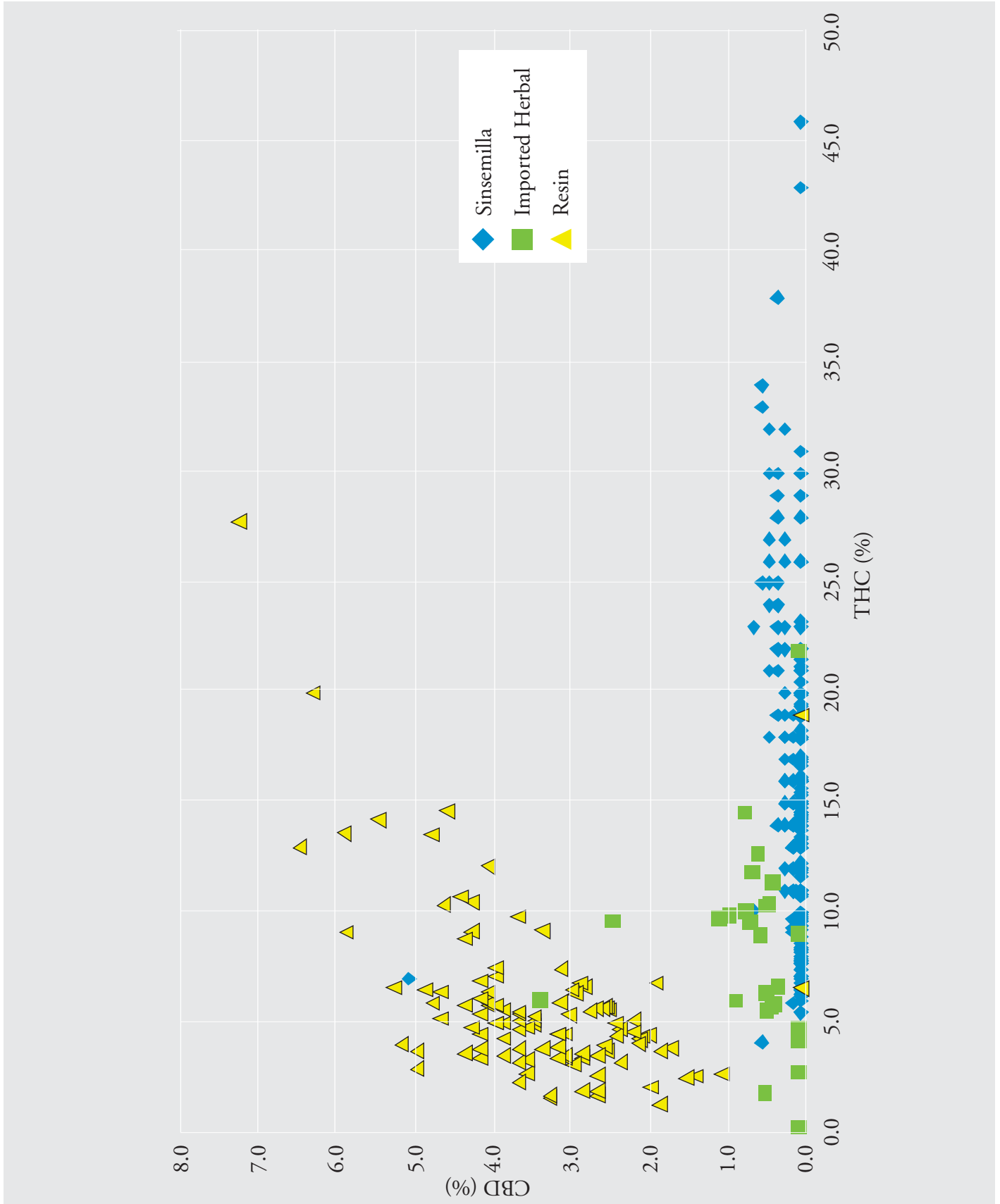
**FIGURE 6** DISTRIBUTION OF THE THC CONCENTRATION (POTENCY) IN THE SAMPLES EXAMINED



**FIGURE 7** DISTRIBUTION OF CBD CONCENTRATIONS IN CANNABIS RESIN



**FIGURE 8** THC AND CBD CONCENTRATIONS IN SAMPLES







# Home Office Cannabis Potency Study 2008

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