



Quality Control of Cannabis by NMR

How to gain a holistic overview of your material with one technique & various approaches

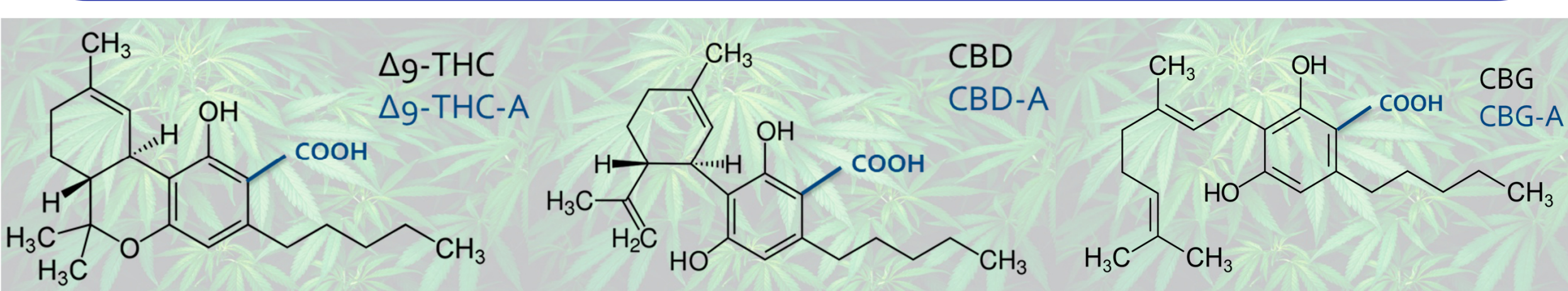
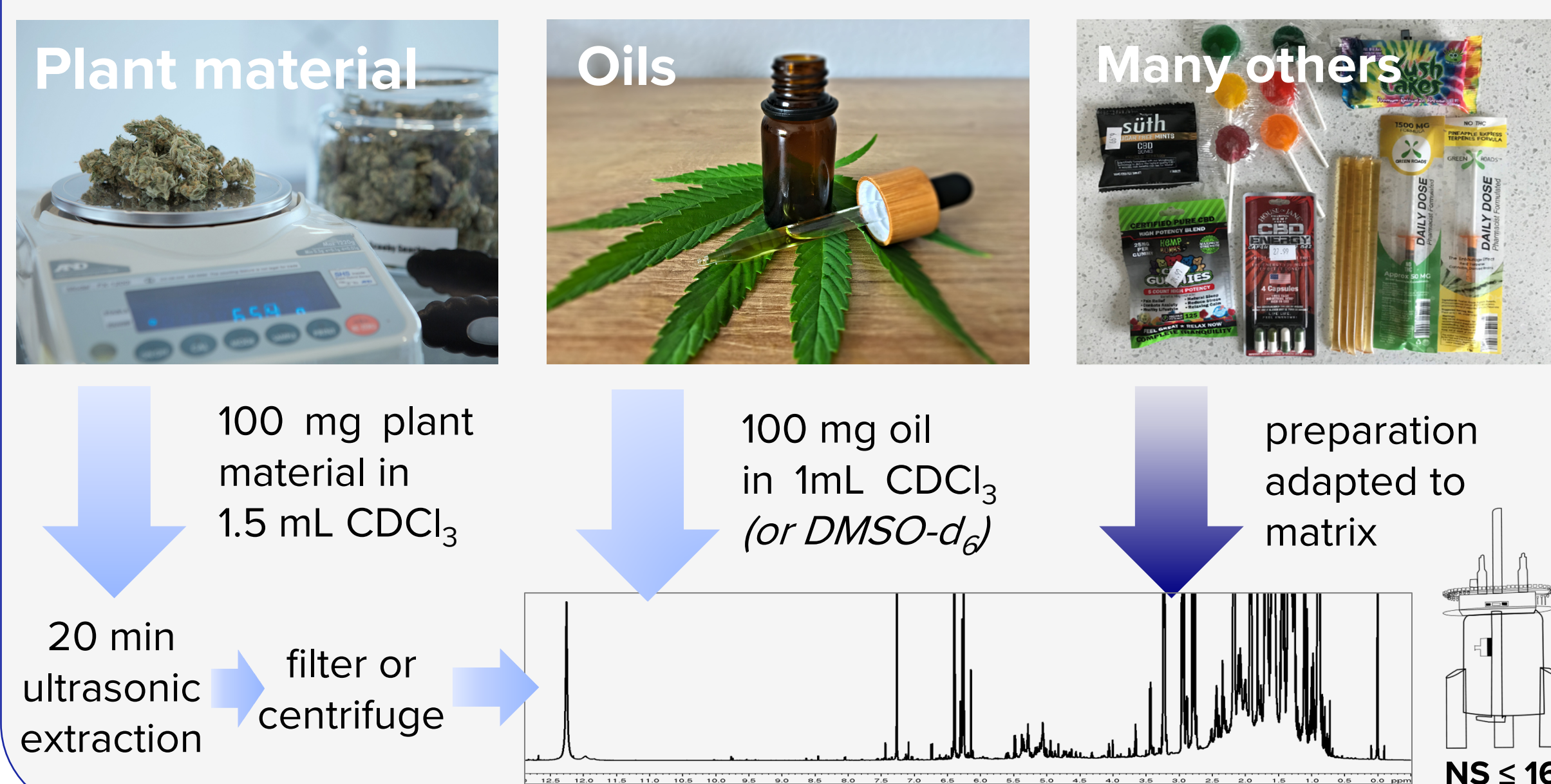
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„Why NMR, why this topic?“

Partial legalization of cannabis in Germany and other countries, alongside an increasingly widespread medical use, the need for robust and reliable quality control has become more important than ever. With NMR a direct analysis of cannabinoids and terpenes in complex samples without prior separation and without the need for reference standards is possible. Within short measurement times, it delivers not only quantitative results but also rich structural information, allowing the identification of both known and unknown compounds. The analysis is easily extended to other matrices of cannabinoid containing products. These aspects underline the key advantage of NMR: a holistic, non-targeted analytical approach that is well suited for quality control from a regulatory GMP perspective.

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Types of samples



Test item screening by NMR



An initial ^1H -NMR qualitative spectrum is acquired for a first overview of the sample's overall composition and defines the downstream investigations. Specific targeted analysis, such as potency testing, terpene profiling or the identification of detected constituents complement the analysis.

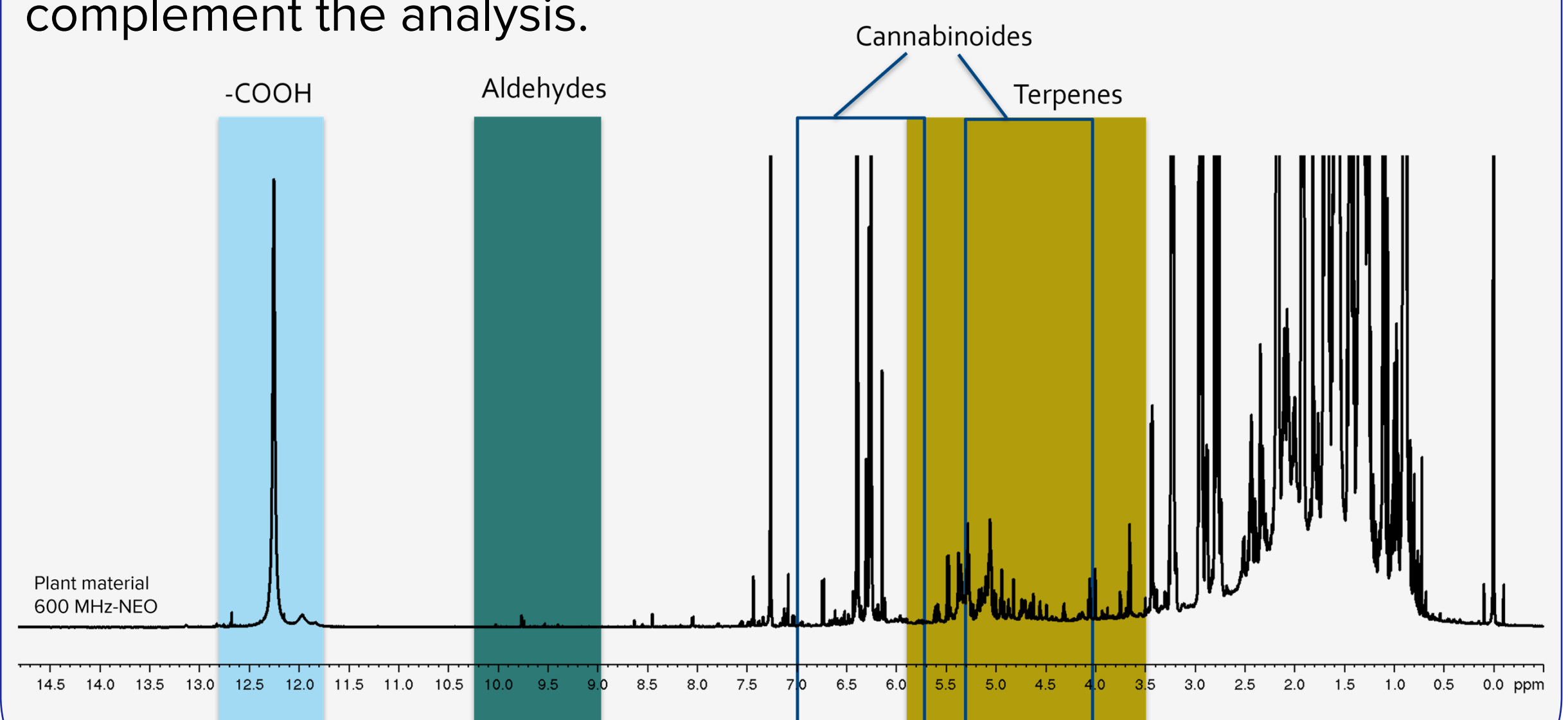


Figure 1: initial ^1H -NMR screening of cannabis plant material with areas of interest marked for ID

Potency testing

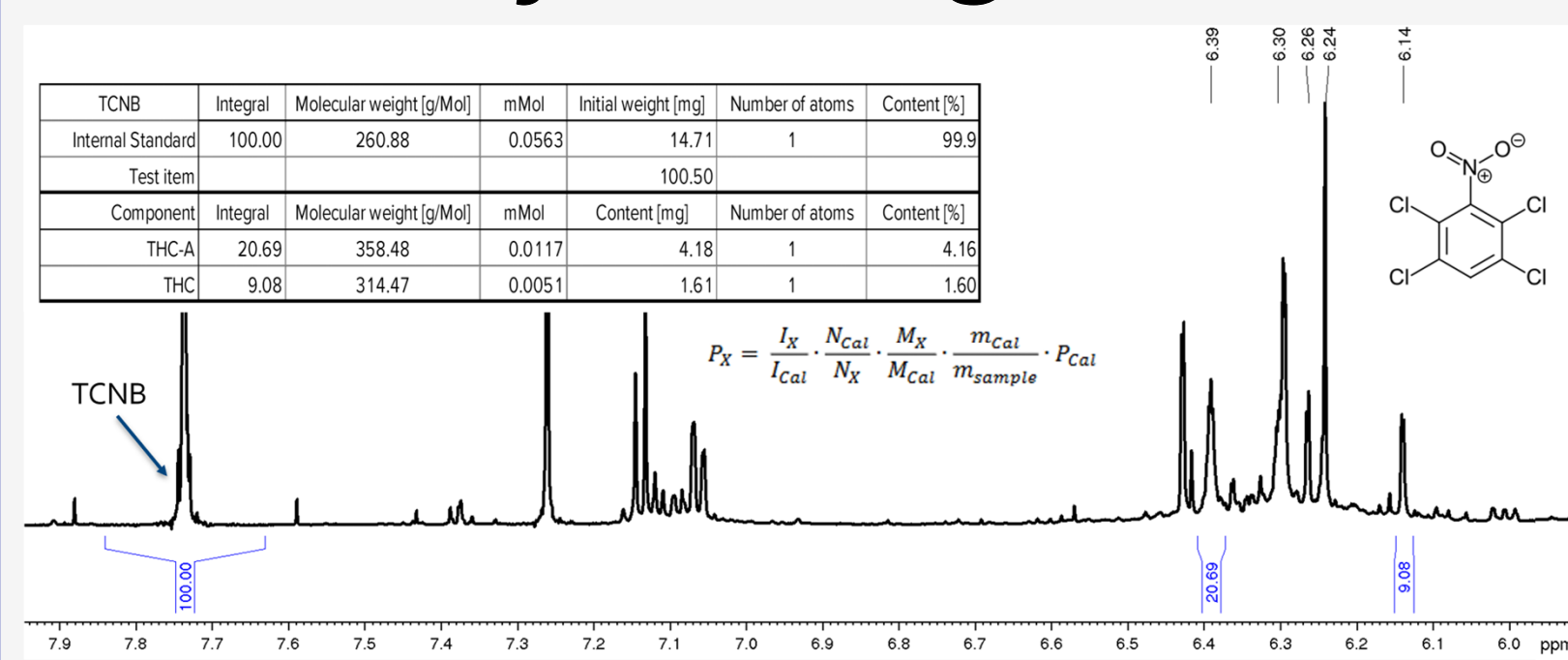


Figure 2: qNMR assay of cannabinoids with TCNB as internal standard

The quantitative assay accurately determines the levels of THC(A), CBD(A), CBG(A), CBN and many more cannabinoids including species that are thermolabile and non-volatile, which gives NMR spectroscopy the upper hand over chromatographic methods, e.g. HPLC and GC.

Terpene profiling

Reference spectra and comparative analysis enables the determination of terpene profile of cannabis samples with subsequent qNMR.

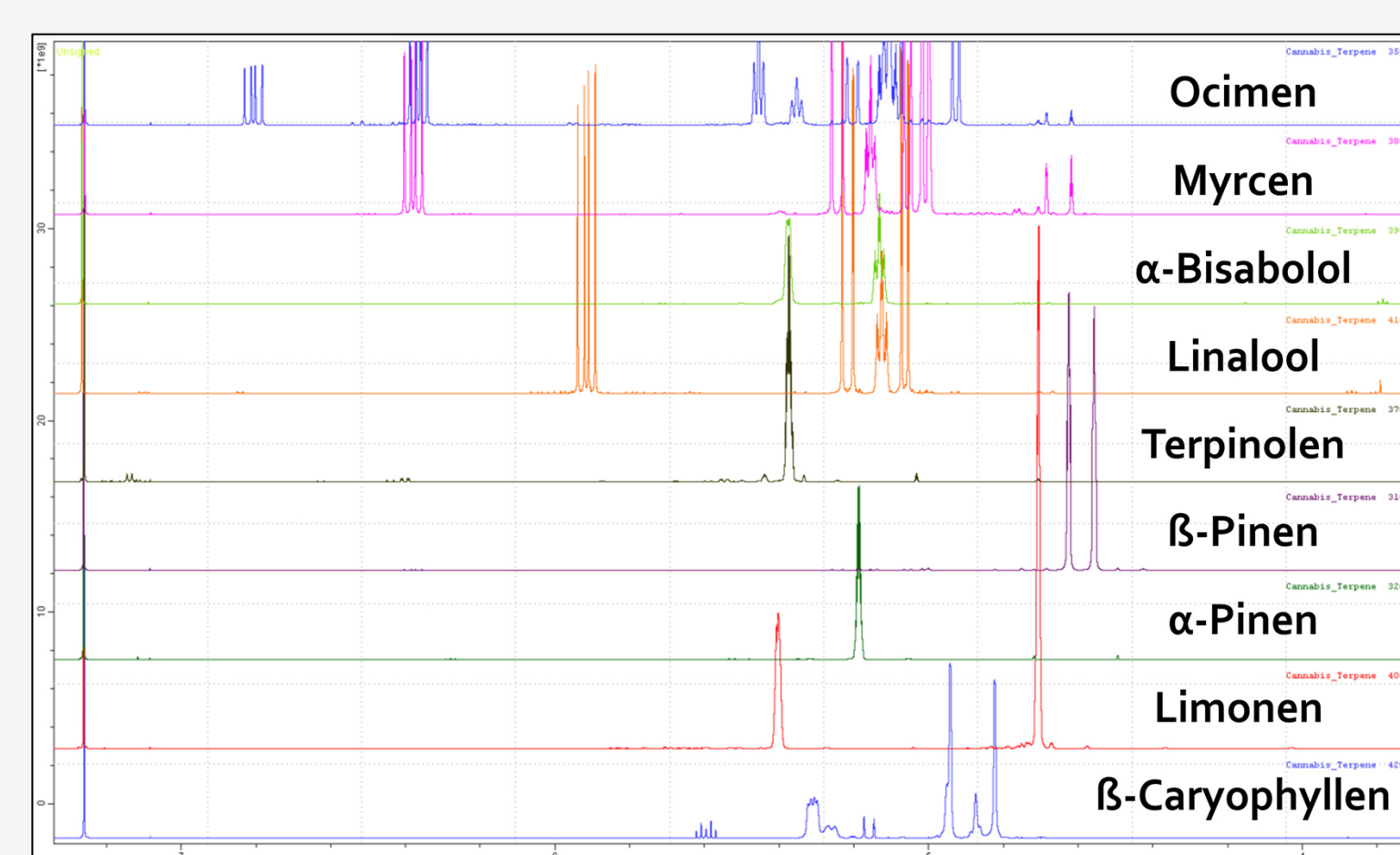


Figure 3: ^1H -NMR overlay of various terpenes & terpenoids (in CDCl_3)

Holistic control

Beyond the specific targeted analysis using (^1H)-NMR spectroscopy provides insights into the cannabis sample that cannot normally be obtained using other methods, such as HPLC or GC. With regard to quality control, this feature might just be the decisive advantage in identifying undesirable compounds and is applicable not only to plant material but also cannabinoid infused products on the market.

Table 1: Sufficient LOD/LOQ with only ^1H -NMR standard parameter set

Parameter (600 MHz)	^1H -NMR Standard
Number of scans	8-16
Relaxation delay	30 sec
Internal Standard	TCNB
LOD/LOQ [mg/mL]	0.003 / 0.009 THC 0.006 / 0.020 THC-A

Conclusion / Take-Home Message

NMR spectroscopy enables rapid, direct, and non-destructive analysis of cannabinoids and terpenes without the need for separation or specific reference standards. It combines quantitative information with structural insight, allowing both targeted and non-targeted investigation of complex cannabis samples within a single experiment. The holistic nature of NMR provides a comprehensive chemical overview in order to identify and quantify known and unknown constituents. This makes NMR a powerful complementary tool for reliable quality control in an evolving cannabis market and has the potential to redefine routine analysis.

