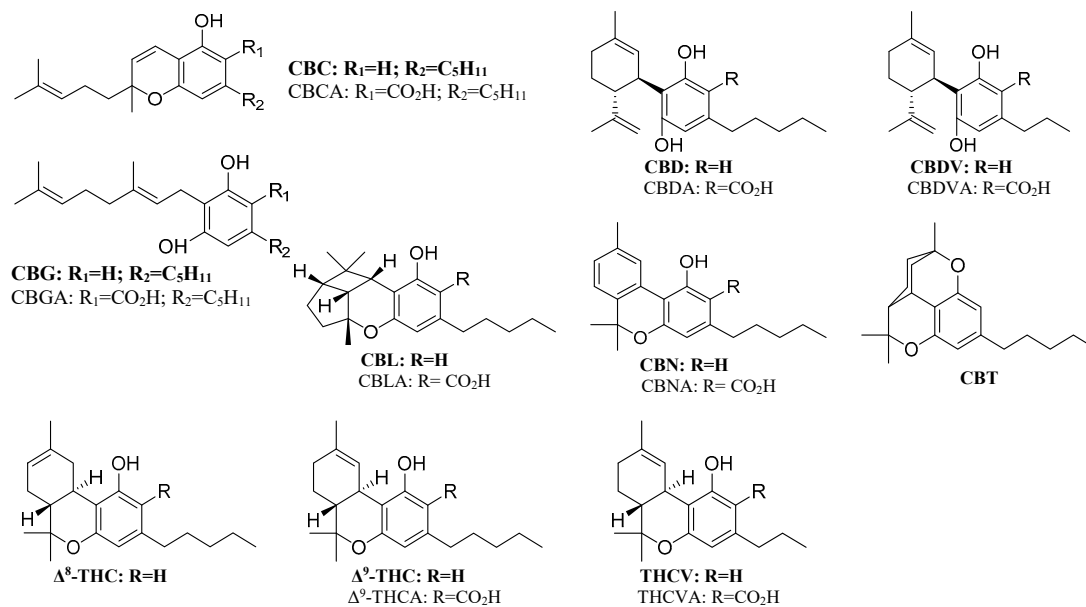
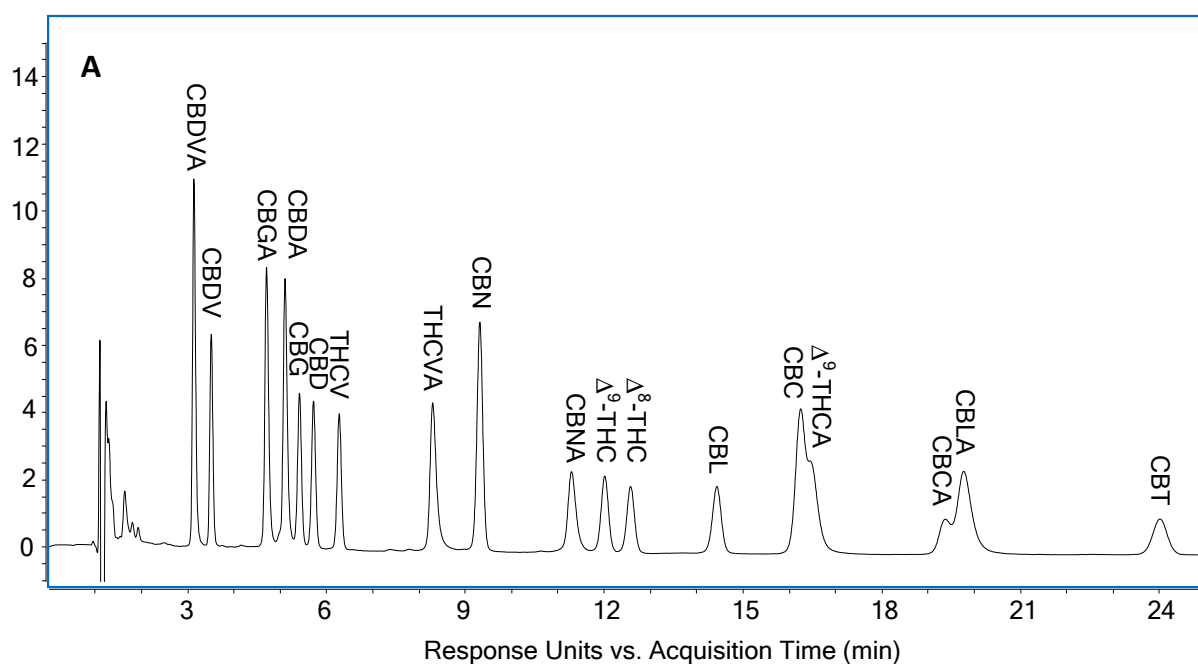
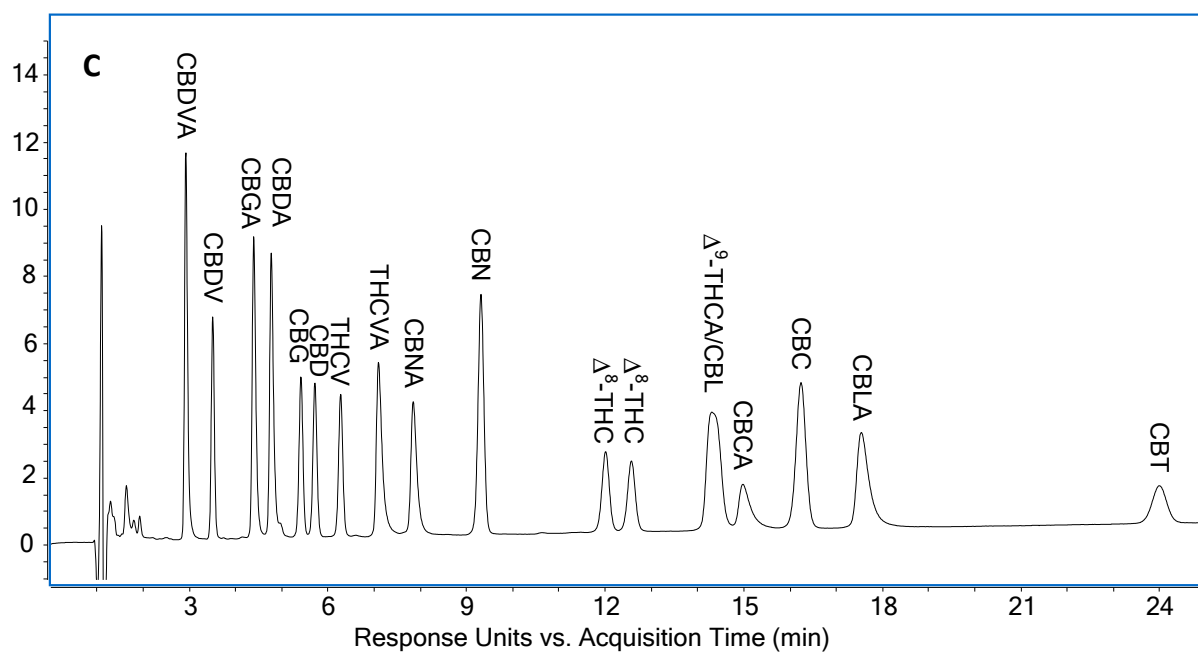
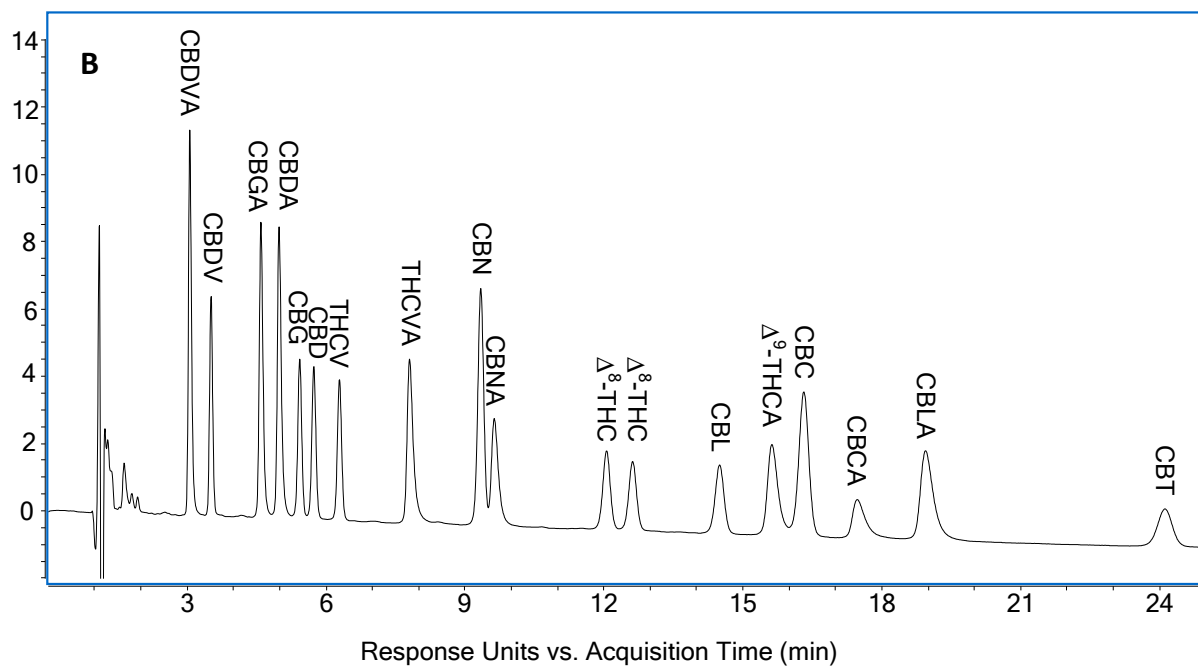


Supplementary Fig. S1. Chemical structure of the eighteen cannabinoids for potency testing of hemp-based products (neutral cannabinoids are marked by bold letters).

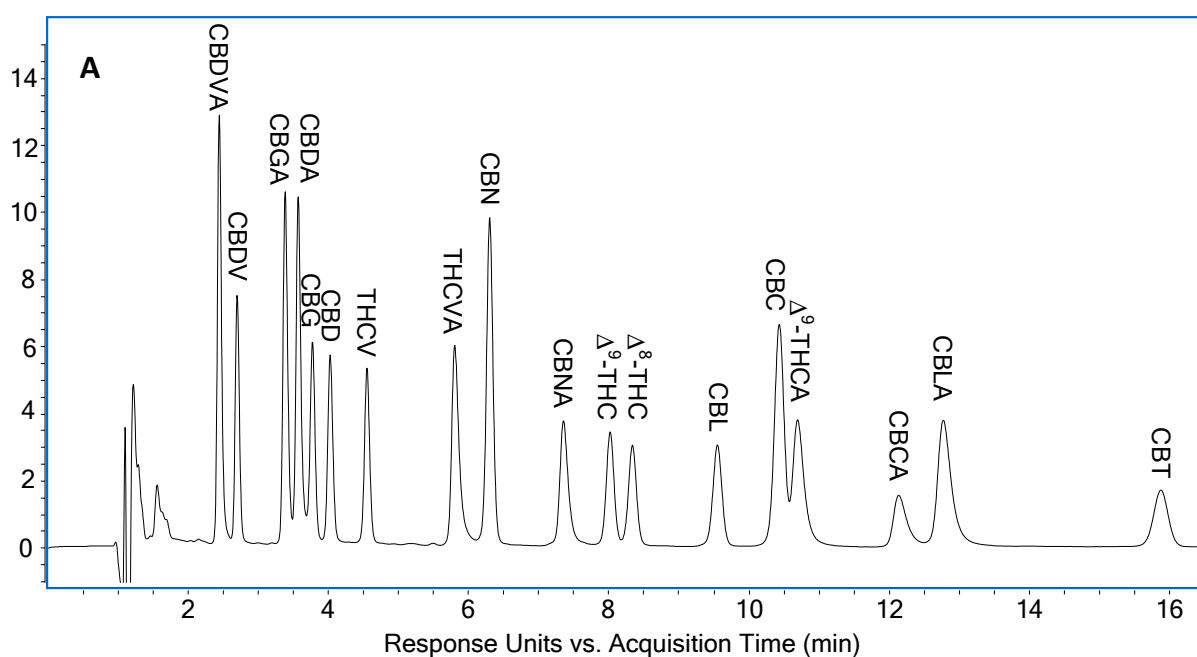


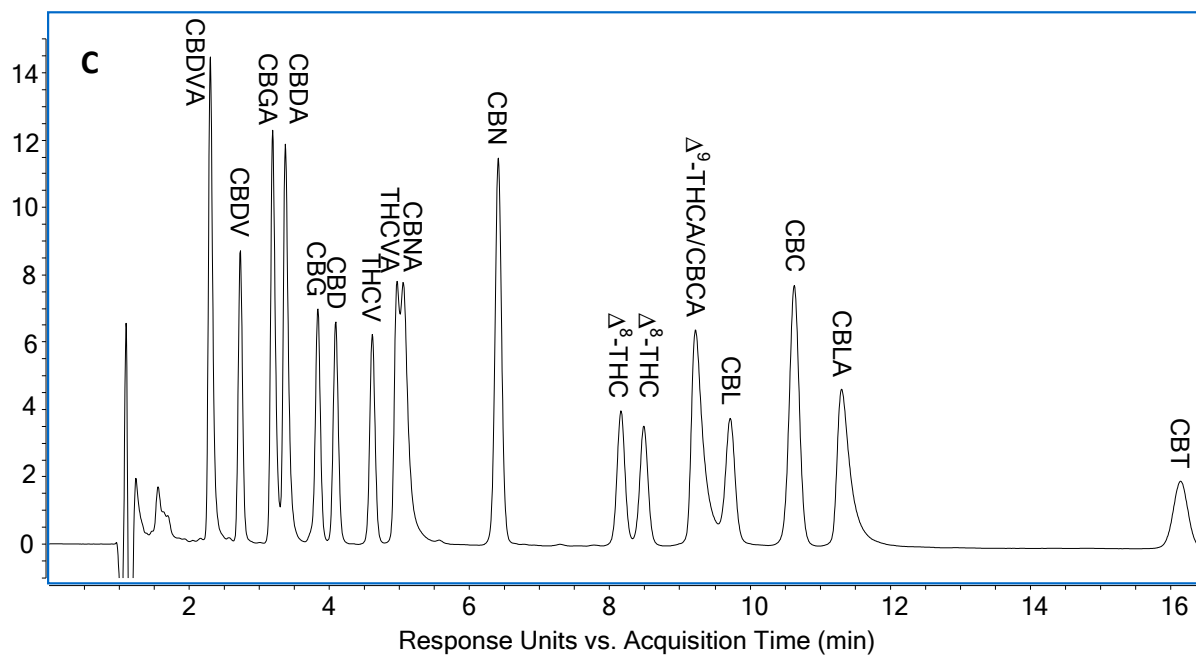
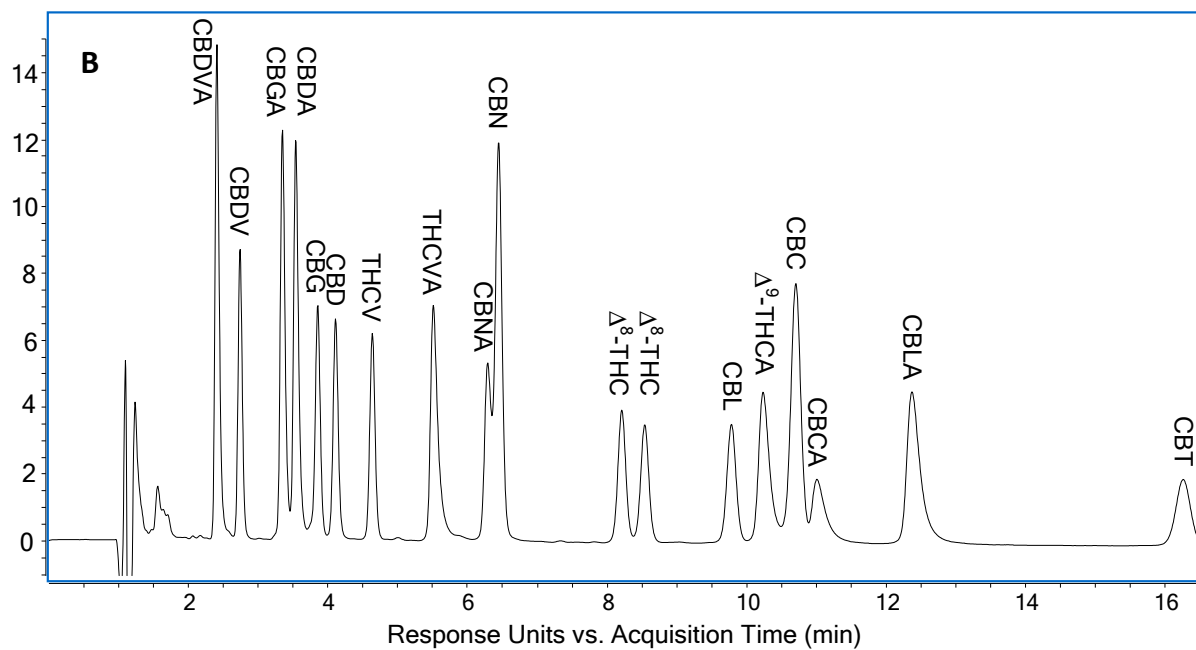
Supplementary Fig. S2. LC separation of the eighteen cannabinoids using Poroshell 120 EC-C18: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), (B) 0.02% HCO₂H + 1 mM NH₄HCO₂ (pH 3.15), and (C) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile; the mobile phase contained **70.0% (v/v) B**; the flow rate was 0.3 mL/min; and the eighteen cannabinoids were at 1 µg/mL individual concentration.



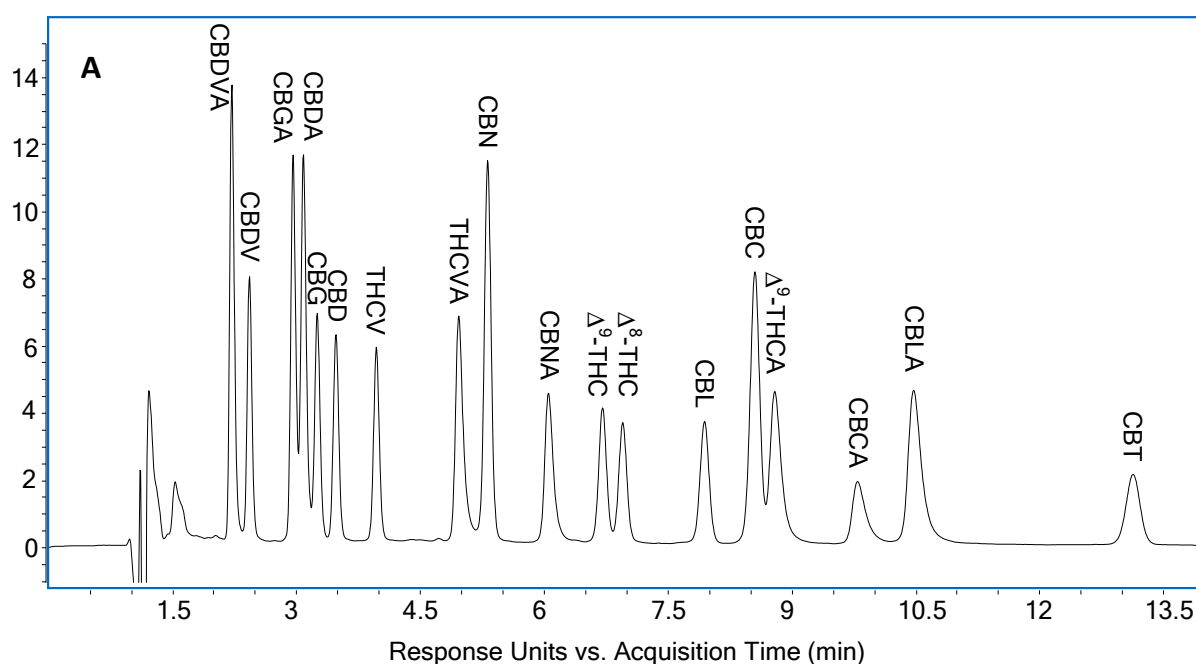


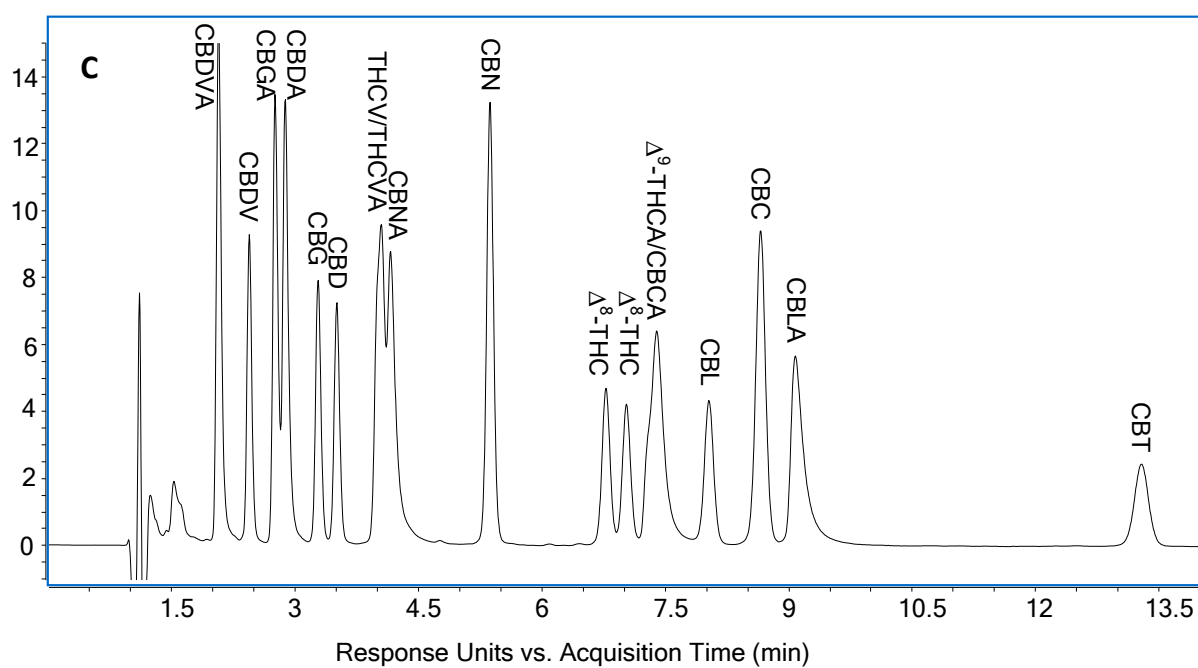
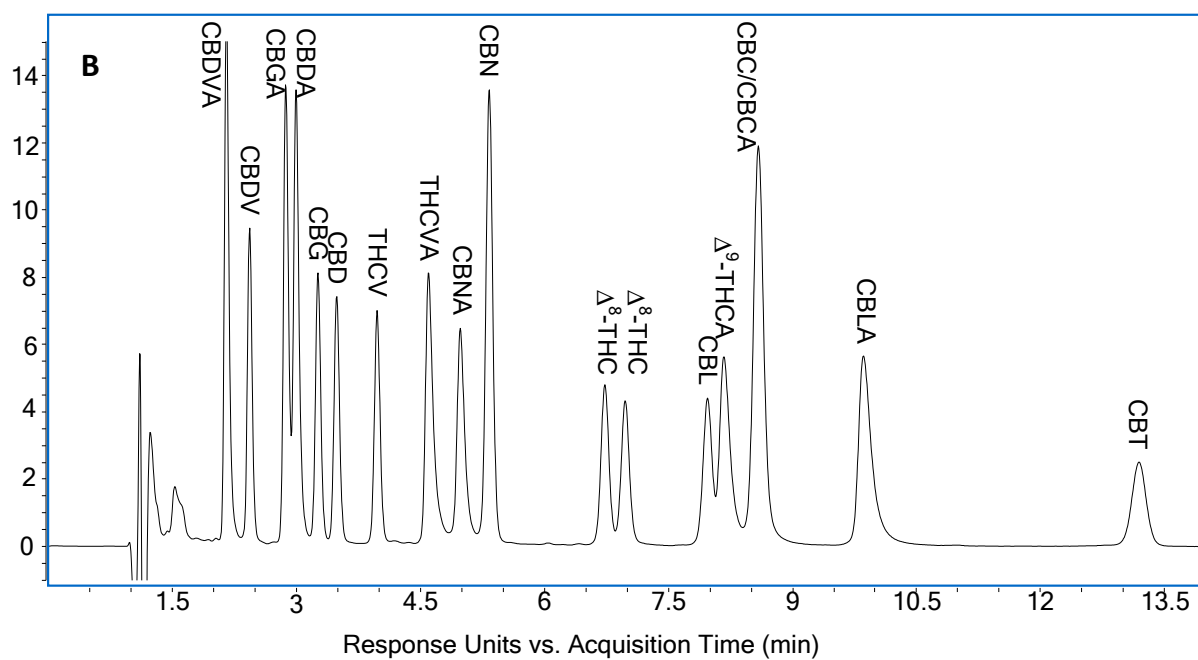
Supplementary Fig. S3. LC separation of the eighteen cannabinoids using Poroshell 120 EC-C18: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), (B) 0.02% HCO₂H + 1 mM NH₄HCO₂ (pH 3.15), and (C) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile; the mobile phase contained **75.0% (v/v) B**; the flow rate was 0.3 mL/min; and the eighteen cannabinoids were at 1 µg/mL individual concentration.



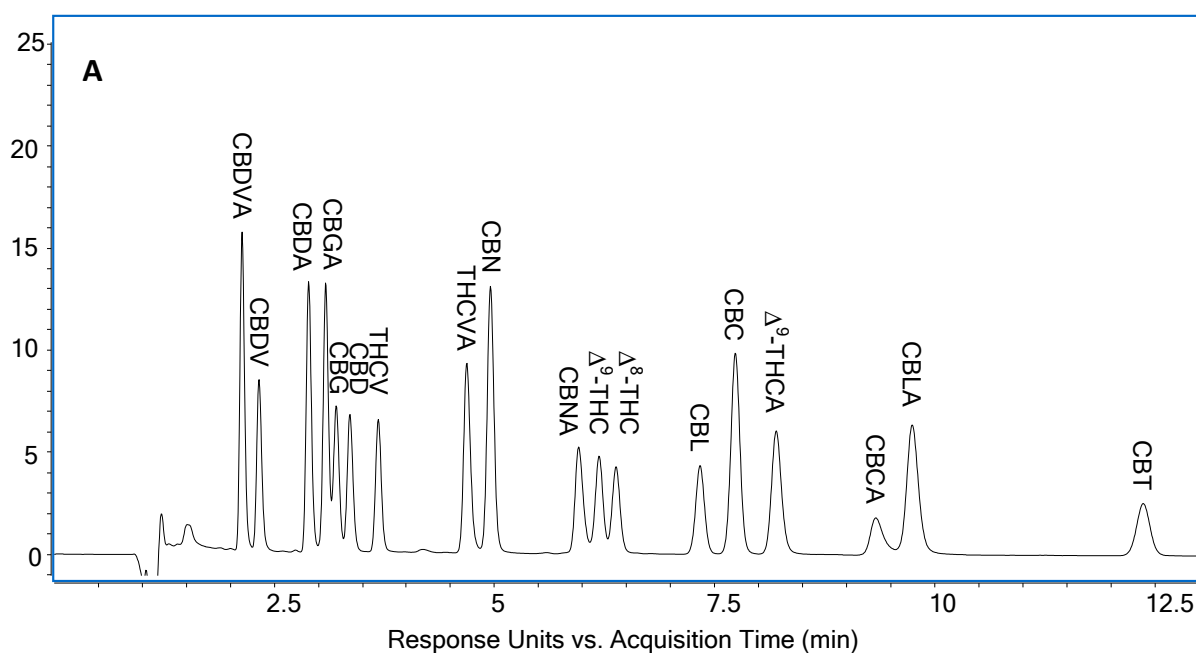


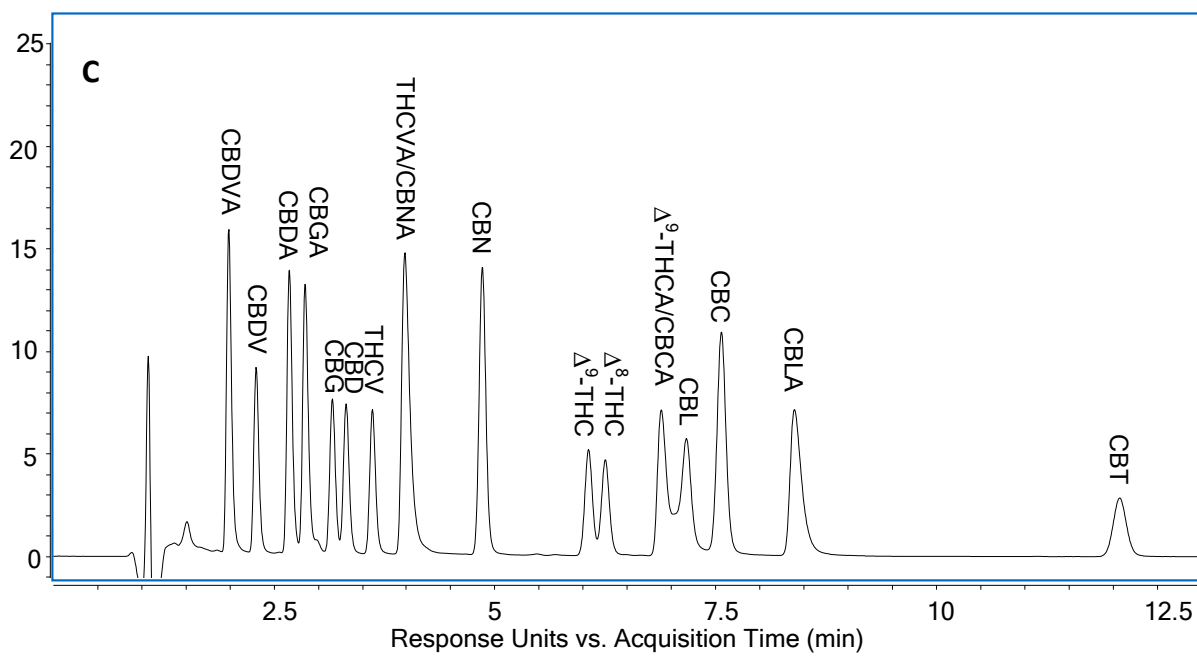
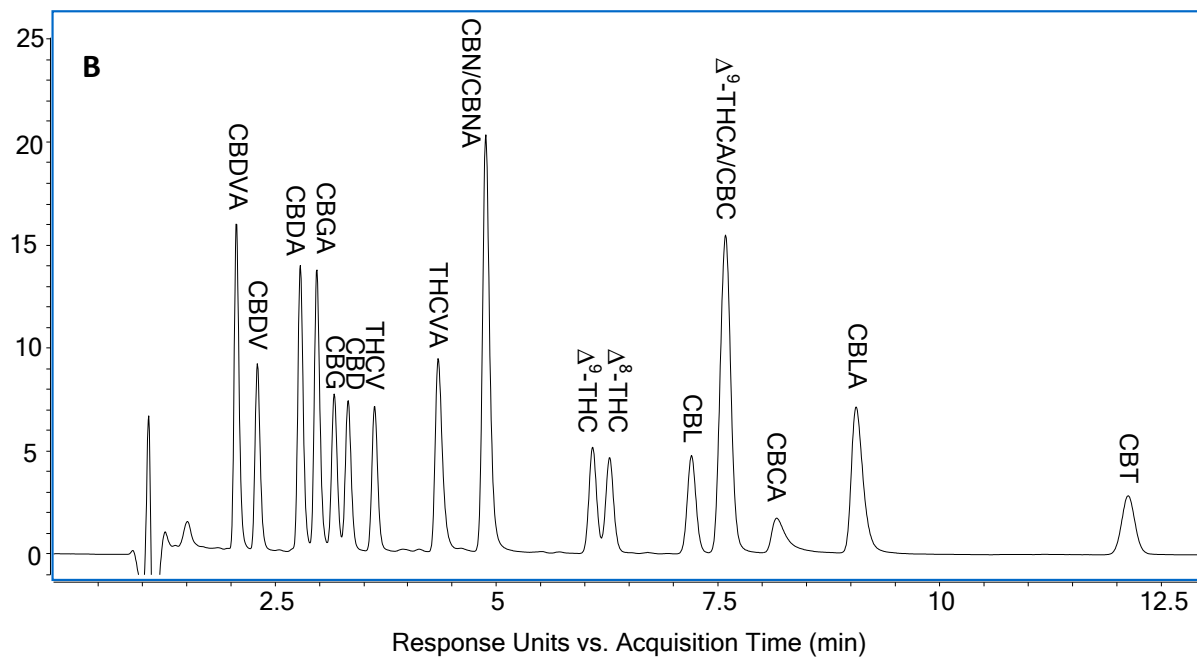
Supplementary Fig. S4. LC separation of the eighteen cannabinoids using Poroshell 120 EC-C18: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), (B) 0.02% HCO₂H + 1 mM NH₄HCO₂ (pH 3.15), and (C) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile, the mobile phase contained **77.5% (v/v) B**; the flow rate was 0.3 mL/min; and the eighteen cannabinoids were at 1 µg/mL individual concentration.



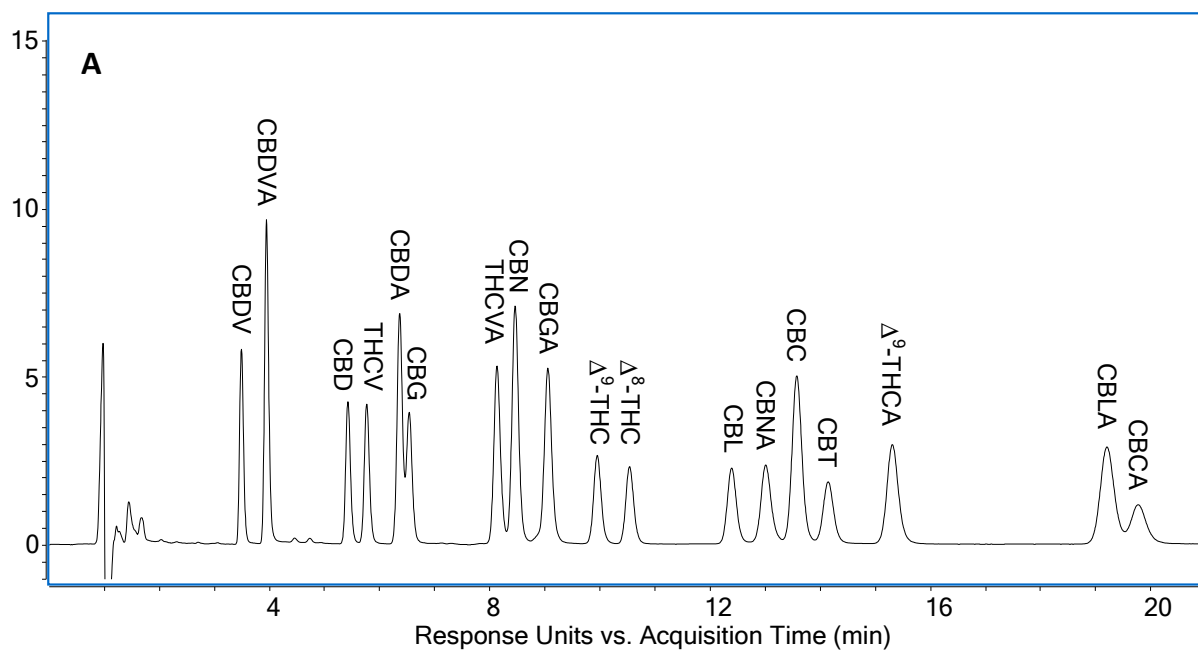


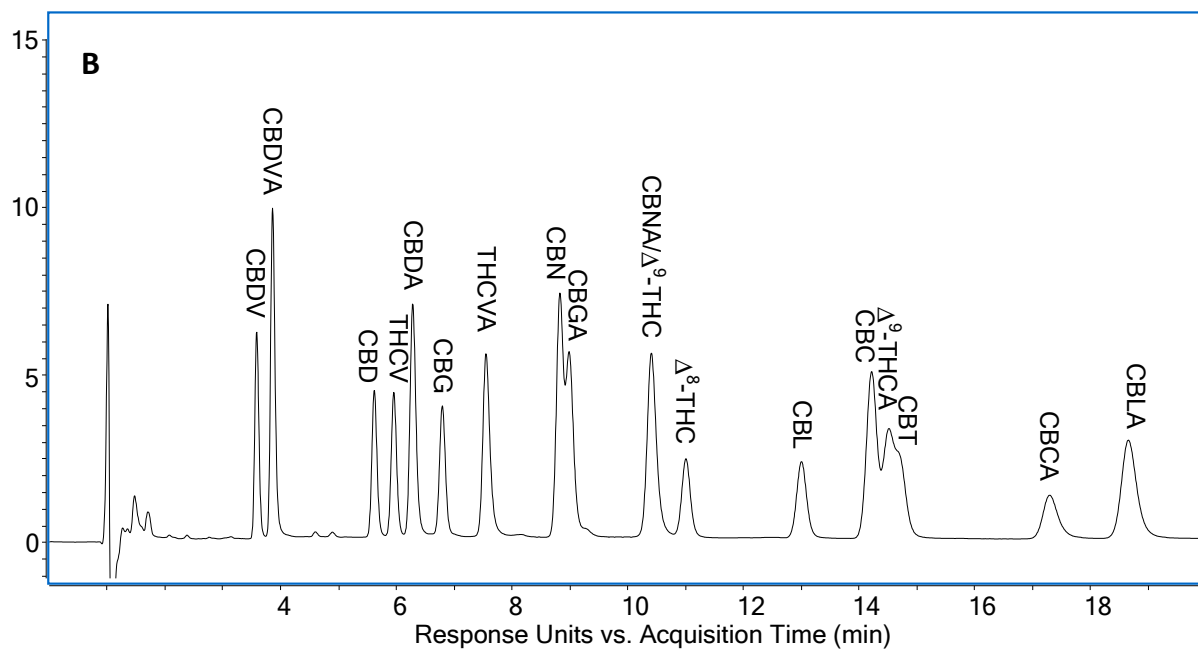
Supplementary Fig. S5. LC separation of eighteen cannabinoids using Raptor ARC-18: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), (B) 0.02% HCO₂H + 1 mM NH₄HCO₂ (pH 3.15), and (C) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile; the mobile phase contained 75.0% (v/v) B; the flow rate was 0.3 mL/min; the eighteen cannabinoids were at 1 µg/mL individual concentration.



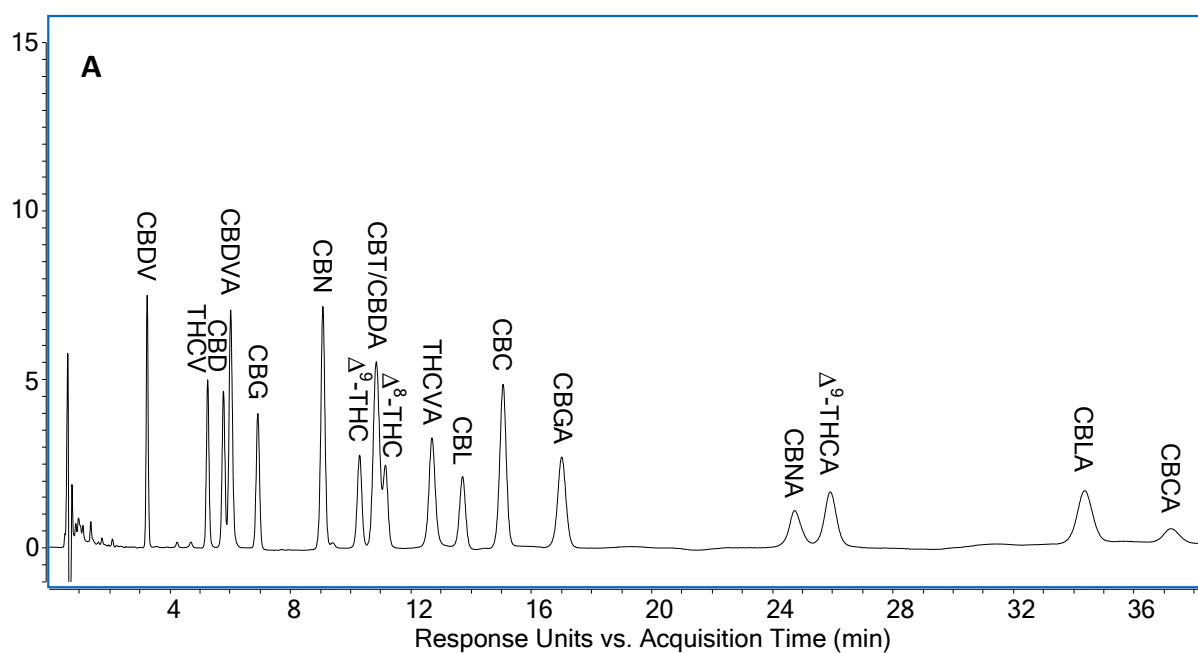


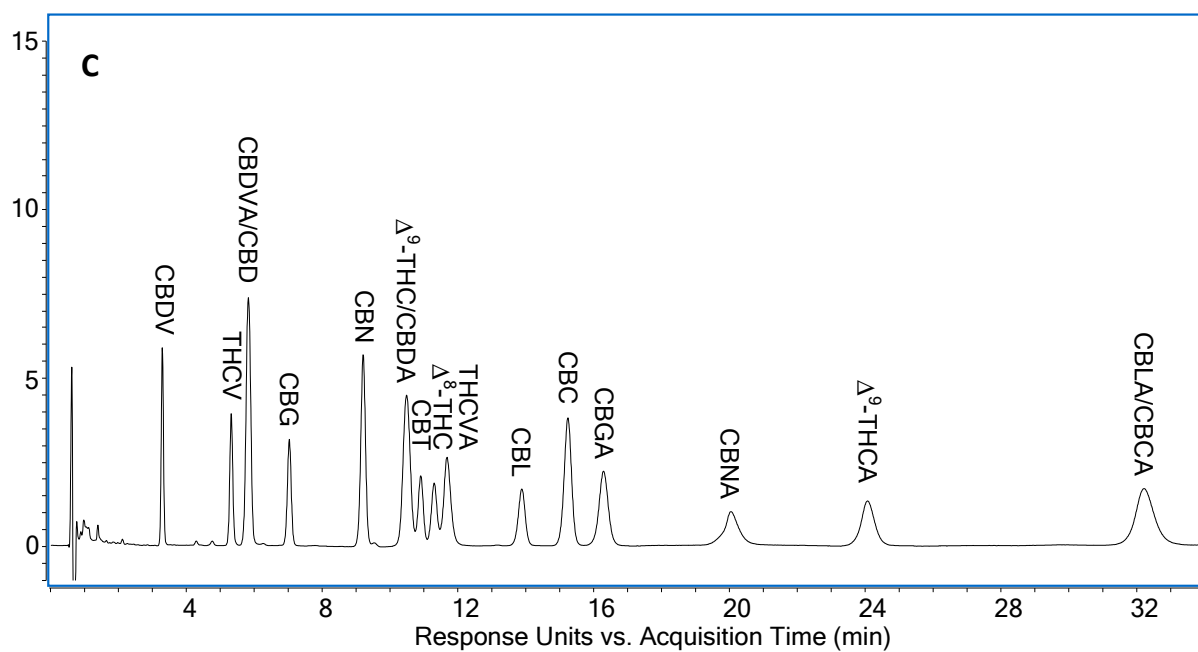
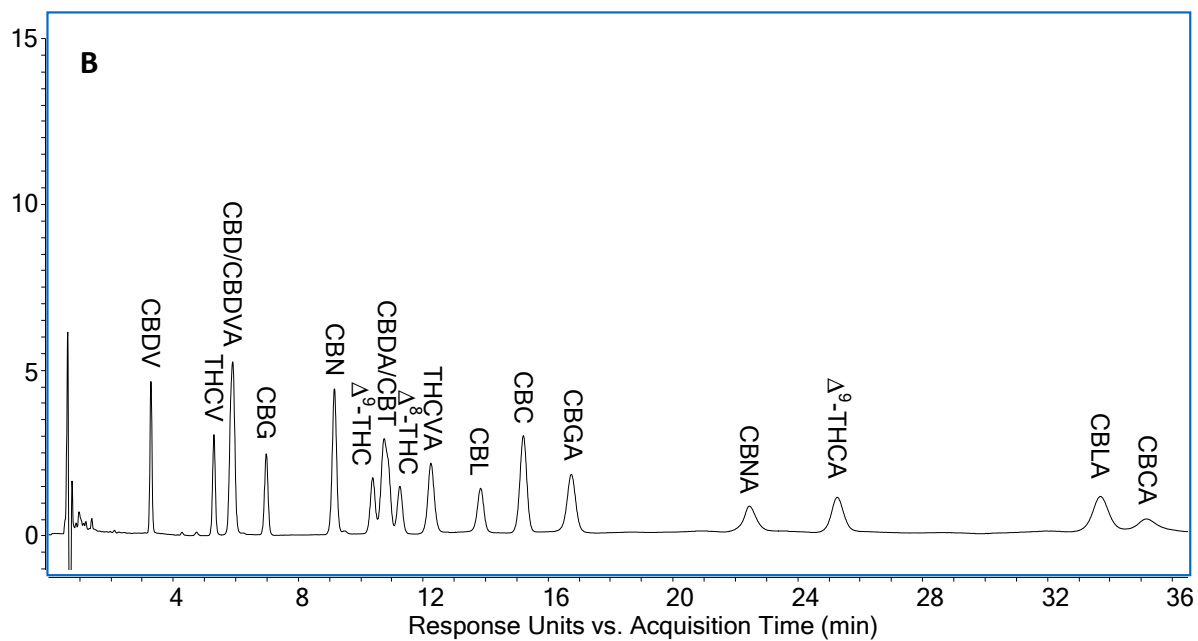
Supplementary Fig. S6. LC separation of eighteen cannabinoids using Cortecs Shield RP-18: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), and (B) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile; the mobile phase contained 65.0% (v/v) B, the flow rate was 0.3 mL/min; the eighteen cannabinoids were at 1 µg/mL individual concentration.

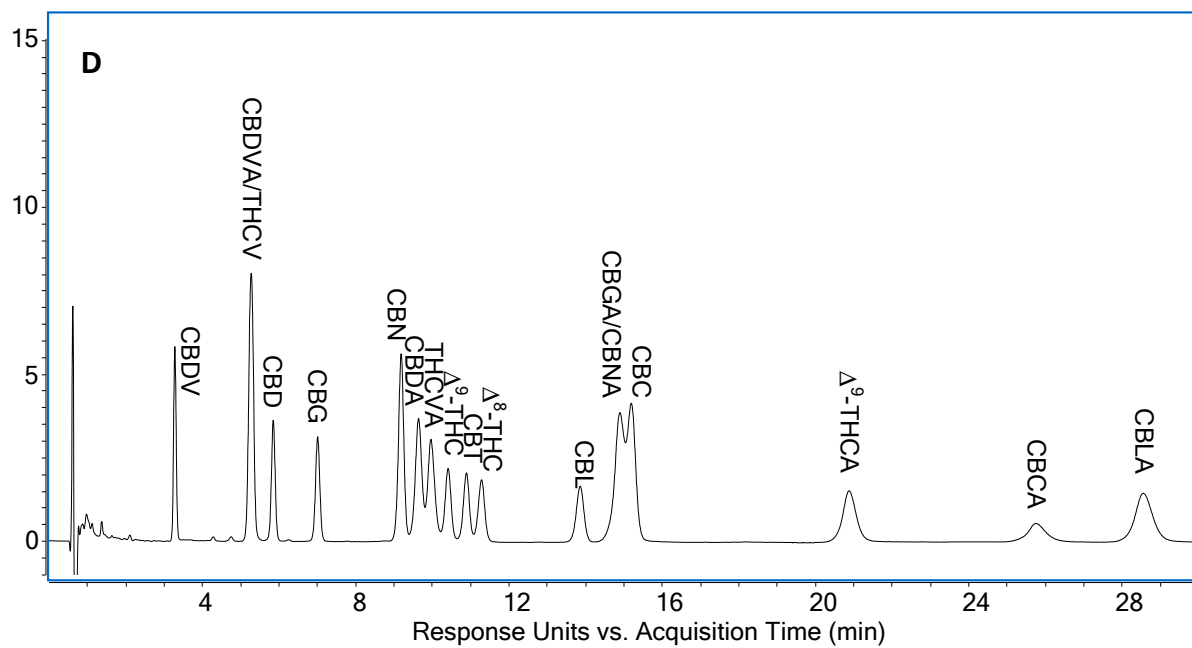




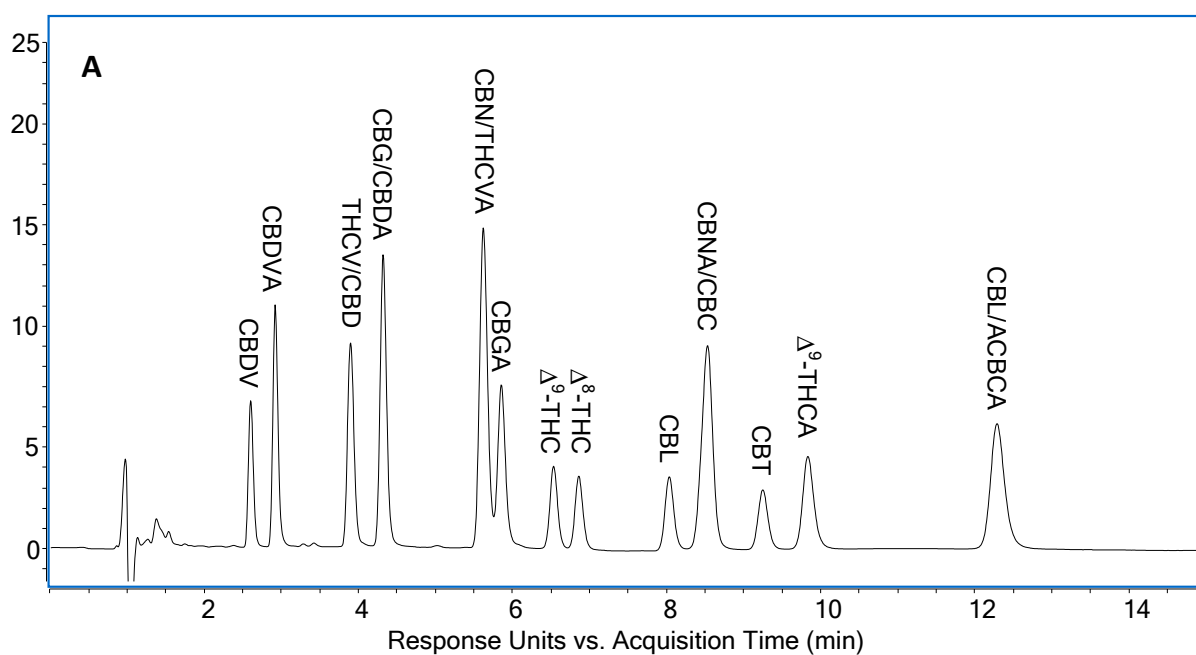
Supplementary Fig. S7. LC separation of eighteen cannabinoids using Ascentis Express RP-Amide: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), (B) 0.02% HCO₂H + 1 mM NH₄HCO₂ (pH 3.15), (C) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38), and (D) 0.01% HCO₂H + 2 mM NH₄HCO₂ (pH 3.55); the B solvent was acetonitrile; the mobile phase contained 65.0% (v/v) B; the flow rate was 0.5 mL/min; the eighteen cannabinoids were at 1 µg/mL individual concentration.

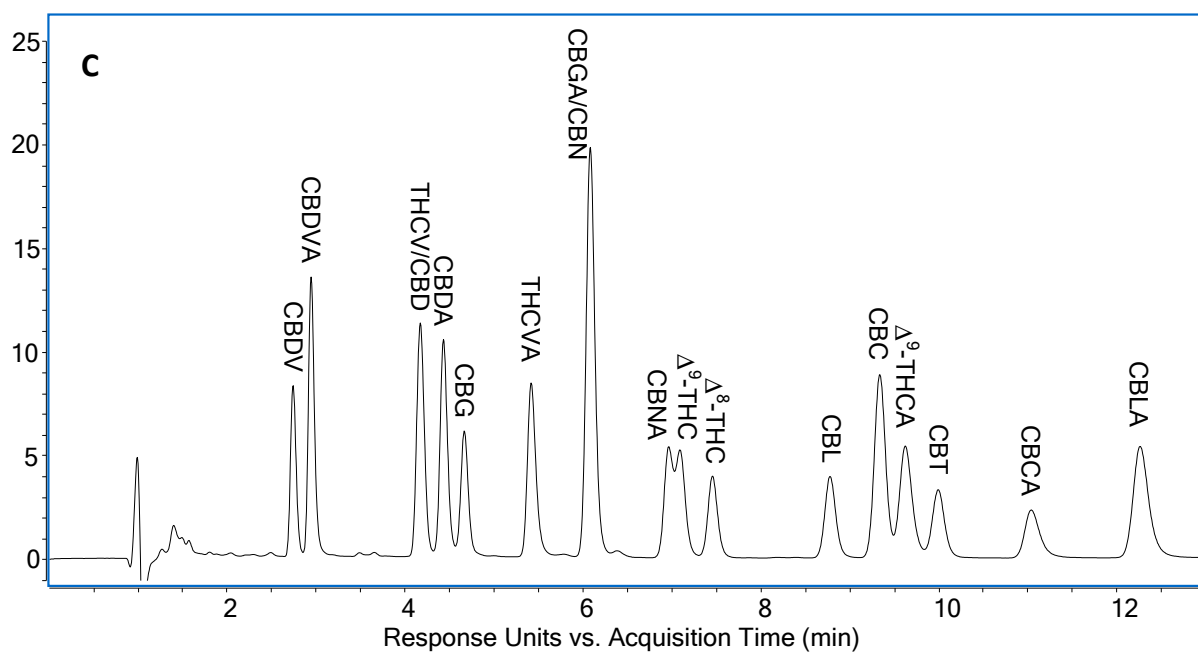
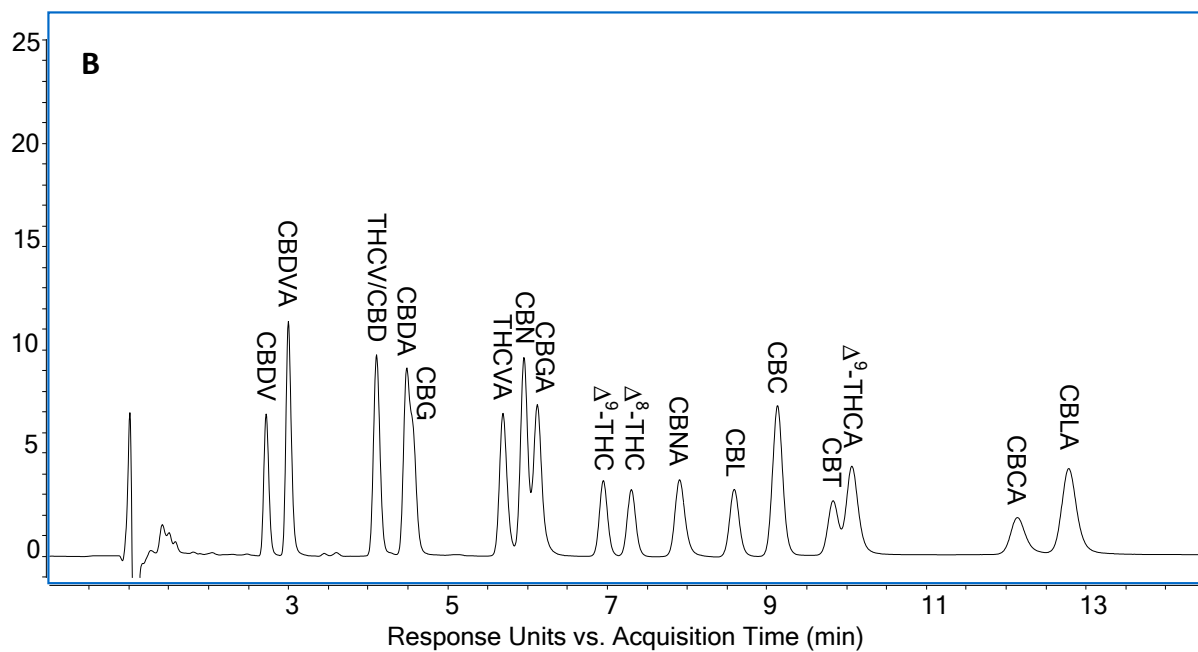






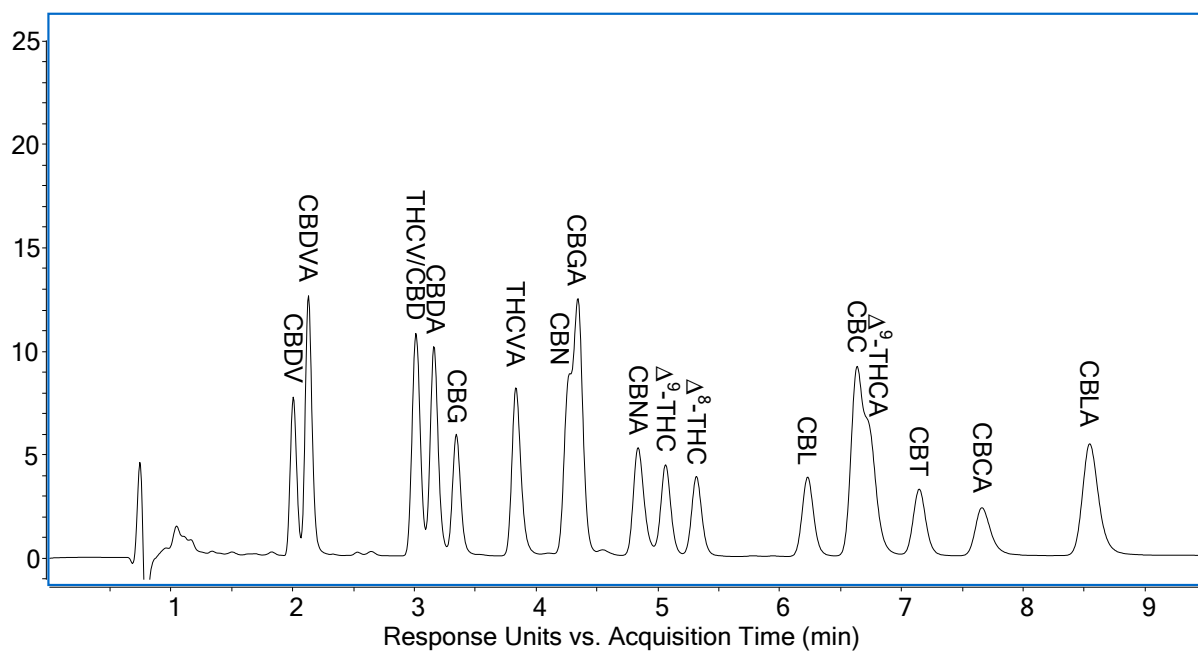
Supplementary Fig. S8. LC separation of the eighteen cannabinoids using Cortecs Shield RP-18: effect of the pH of the A solvent on the separation. The A solvent was (A) 0.03% HCO₂H + 0.5 mM NH₄HCO₂ (pH 2.97), (B) 0.02% HCO₂H + 1 mM NH₄HCO₂ (pH 3.15), (C) 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile; the mobile phase contained 70.0% (v/v) B; the flow rate was 0.3 mL/min; the eighteen cannabinoids were at 1 µg/mL individual concentration.





Supplementary Fig. S9. LC separation of eighteen cannabinoids using Cortecs Shield RP-18.

The A solvent was 0.01% HCO₂H + 1 mM NH₄HCO₂ (pH 3.38); the B solvent was acetonitrile; the mobile phase contained 70.0% (v/v) B; the flow rate was 0.4 mL/min; the eighteen cannabinoids were at 1 µg/mL individual concentration.



Supplementary Table S1

Published LC-DAD methods that were able to quantify fourteen and more cannabinoids for potency testing of hemp-based products (neutral cannabinoids are in bold font).

Ref.	Column and temperature	Mobile phase	Order of elution
18	Restek Raptor ARC-18 150 × 4.6 mm × 2.7 μm	A: 0.1% HCO ₂ H + 5 mM NH ₄ HCO ₂ /H ₂ O B: 0.1% HCO ₂ H/MeCN 75% B for 11 min	CBDVA, CBDV , CBDA, CBGA, CBG , CBD , THCV , THCVA , CBN , CBNA, Δ⁹-THC , Δ⁸-THC , CBL , CBC , Δ⁹-THCA , CBLA, CBCA
13	Restek Raptor ARC-18 2 × 150 × 4.6 mm × 2.7 μm 30 °C	A: 0.02% HCO ₂ H + 0.5 mM NH ₄ HCO ₂ /H ₂ O (pH3.0) B: MeCN 75% B for 19 min 0.4 mL/min	CBDVA, CBDV , CBDA, CBGA, CBG , CBD , THCV , ACBD , CBCV , THCVA , CBN , CBNA, Δ⁹-THC , Δ⁸-THC , CBL , CBC , Δ⁹-THCA , Δ⁸-THCA , CBCA, CBLA, CBT
19	Phenomenex Luna C18(2) 250 mm × 4.6 mm × 3 μm 40 °C.	A: 0.1% HCO ₂ H/H ₂ O B: 0.1% HCO ₂ H/MeCN 0-10 min, 75% B, 1 mL/min 10.1-30 min, 75% B, 1.2 mL/min	CBDVA, CBDV , CBDA, CBGA, CBG , CBD , THCV , THCVA , CBN , CBNA, Δ⁹-THC , Δ⁸-THC , CBL , CBC , Δ⁹-THCA , CBCA
20	Shimadzu Shim-Pak C18 75 mm × 3 mm × 2.2 μm + Phenomenex Synergy C18 2 × 100 mm × 3 mm × 2.5 μm 40 °C	A: 0.1% HCO ₂ H/MeCN B: 0.1% HCO ₂ H/H ₂ O C: MeOH A ternary gradient involving 15 steps to change flow rate, %B and %C	CBDVA, CBDV , CBDA, CBGA, CBG , CBD , THCV , THCVA , CBN , Δ⁹-THC , Δ⁸-THC , CBNA, CBL , CBC , Δ⁹-THCA , CBCA, CBLA
14	Restek Raptor ARC-18 150 × 4.6 mm × 2.7 μm 30 °C	A: 0.015% HCO ₂ H/H ₂ O B: 75/25 MeOH/MeCN 74.5% B for 17.5 mins, 0.3 mL/min 80.5% B for 6.5 min, 0.3 mL/min	CBDV , CBDVA, CBD , CBG , THCV , CBDA, CBGA, ACBD , CBN , Δ⁹-THC , THCVA , Δ⁸-THC

		74.5% B for 6 mins, 0.5 mL/min 74.5% B for 2 mins, 0.3 mL/min	THC, CBL, CBC, CBNA, CBT, Δ^9-THCA, CBLA, CBCA
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Supplementary Table S2

Published LC-ESI/MS/MS methods that were able to quantify fourteen and more cannabinoids for potency testing of hemp-based products (neutral cannabinoids are in bold font).

Ref.	Column and temperature	Mobile phase	Order of elution
21	ACE C18-Amide 100 mm × 2.1 mm × 3 µm 40 °C	A: 0.1% HCO ₂ H/H ₂ O B: 0.1% HCO ₂ H/MeCN 0–5 min, 57-70% B 5.0–11.0 min, 70-75% B 11.0–13.0 min, 75-80% B 13.0–14.0 min, 80-95% B 14.0–18.0 min, 98% B 18.0–22.0 min, 57% B. 0.5 mL/min	CBDV , THCV , CBDVA, CBD , CBG , THCVA, CBN , Δ⁹-THC , Δ⁸-THC , CBC , CBDA, CBL , CBNA, Δ⁹- THCA, CBGA, CBCA, CBLA
22	Supelco Ascentis Express C18 150 mm × 3.0 mm × 2.7 µm 25 °C	A: 0.1% HCO ₂ H + 2 mM NH ₄ HCO ₂ /H ₂ O B: 0.1% HCO ₂ H/MeCN 0-20 min, 70-90% B 0.3 mL/min	CBGV, CBDV , CBDA, CBGA, CBG , CBNR , CBD , CBCV , CBN , CBCA, Δ⁹-THC , Δ⁸-THC , CBC , Δ⁹-THCA
23	Waters Acquity UPLC BEH C18 150 mm × 2.1 mm × 1.7 µm 30 °C	A: 0.1% HCO ₂ H/H ₂ O B: 0.1% HCO ₂ H/MeCN 0-1.5 min, 40–70% B 1.5-15.5 min, 70–100% B 15.5-16 min, 100–40% B 16.0-18.0 min, 40% B 0.3 mL/min	CBDVA, CBDV , CBDA, CBD , CBG /CBGA, THCV , CBN /THCVA, Δ⁹-THC , CBNA, CBL , CBC , Δ⁹- THCA, CBCA, CBLA
24	Phenomenex Luna Omega C18 150 mm × 2.1 mm × 1.6 µm 40 °C	A: 0.1% HCO ₂ H/H ₂ O B: 0.1% HCO ₂ H/MeCN 0-5 min, 70% B 5–7 min, 100% B 7–7.1 min, 70% B	CBDVA, CBDV , CBDA, CBGA, CBG , CBD , THCV , THCVA, CBN , CBNA, Δ⁹-THC/Δ⁸-THC , CBL/CBC , Δ⁹-THCA , CBCA

		7.1–8 min, 70% B 0.4 mL/min	
15	Phenomenex Luna Omega Polar C18 150 mm × 2.1 mm × 1.6 μm 30 °C	A: 0.011% HCO ₂ H + 2 mM NH ₄ HCO ₂ /H ₂ O (pH3.6) B: MeCN 73% B for 18 min 0.3 mL/min	CBDVA, CBDV , CBDA, CBGA, CBNA, THCVA, CBG , CBD , THCV , ACBD , CBN , CBCA, Δ ⁹ -THCA, Δ ⁹ - THC , Δ ⁸ -THC, CBLA, CBL , CBC , CBT

Supplementary Table S3

Published LC-ESI/MS methods that were able to quantify fourteen and more cannabinoids for potency testing of hemp-based products

(neutral cannabinoids are in bold font).

Ref.	Column and temperature	Mobile phase	Order of elution
25	Waters Cortecs C18 2.1 mm × 100 mm × 1.6 μm 20 °C	A: 0.02% HCO ₂ H + 5 mM NH ₄ HCO ₂ /H ₂ O B: MeCN 75% B for 10 min 0.3 mL/min.	CBDVA, CBDV , CBDA, CBGA, CBG , CBD , CBNA, THCVA, THCV , CBN , CBCA, Δ⁹-THC , Δ ⁹ -THCA, Δ⁸-THC , CBLA
26	Agilent Poroshell C18 50 mm × 2.1 mm × 2.7 μm 30 °C	A: 0.1% HCO ₂ H/30%MeOH/H ₂ O B: 0.1% HCO ₂ H/MeCN 0–25 min, 53% B 5–40 min, 53–70% B 40–42 min, 70–97% B 42–43 min, 97%B 43–44 min, 97-53%B 44–50 min, 53%B 0.3 mL/min	CBDV , CBDVA, CBDA, CBD/CBG , THCV , CBGA, THCVA, CBN , Δ⁹-THC , Δ⁸-THC , CBL , CBNA, CBC , Δ ⁹ -THCA, CBLA, CBCA

Supplementary Table S4

Theoretical plate numbers (N) of the ten neutral cannabinoids using 70.0% (v/v) acetonitrile in the mobile phase. The A solvent was 0.02% (v/v) HCO₂H.

Column	Cortecs	Raptor	Poroshell	Ascentis
CBDV	8521	10879	14085	11907
CBG	18789	23022	24724	25349
CBD	15145	18988	23390	19440
THCV	15224	19677	24224	17919
CBN	20950	28826	32273	27352
Δ^9 -THC	24566	30586	32566	27262
Δ^8 -THC	28177	38576	37029	28438
CBL	33434	41562	38260	37541
CBC	33784	45645	38570	38218
CBT	27413	37783	35289	23044