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Analytical challenges in cannabinoid quantification of cannabis based products

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INTRODUCTION

Cannabinoid-containing consumer products exist in a market having fragmented regulations, with cannabis-based formulations falling under different legal classifications depending on their authorisation, source and potency [1]. These products must comply with regulatory limits on Δ9-tetrahydrocannabinol (THC), typically 0.2%, and should provide information on cannabidiol (CBD) content [2]. Discrepancies between labelled and measured CBD concentration have been reported [3,4]. In response, European agencies have called for strengthened monitoring of cannabis products and improved data on potency and composition [3].

AIMS

The aim is to identify matrix-driven analytical challenges affecting cannabinoid quantification when using High-Performance Liquid Chromatography with Ultraviolet detection (HPLC-UV).

METHOD

Cannabinoids were analysed in different matrices using HPLC-UV method. Method was applied to determine cannabinoids in the following matrices: oil (n = 23), cosmetic (n = 10) and plant material samples (n = 5). The conditions for the separation of eleven cannabinoids comprised the NextLeaf CBX column (150 × 4.6 mm; 2.7 µm) maintained at 30 °C, with a mobile phase of ACN and 0.25% acetic acid containing 1 mM ammonium acetate (70:30, v/v) at a flow rate of 1.2 ml/min (Figure 1). Challenges related to sample preparation and analysis of cannabinoids in different matrices were identified and corrective action was taken.

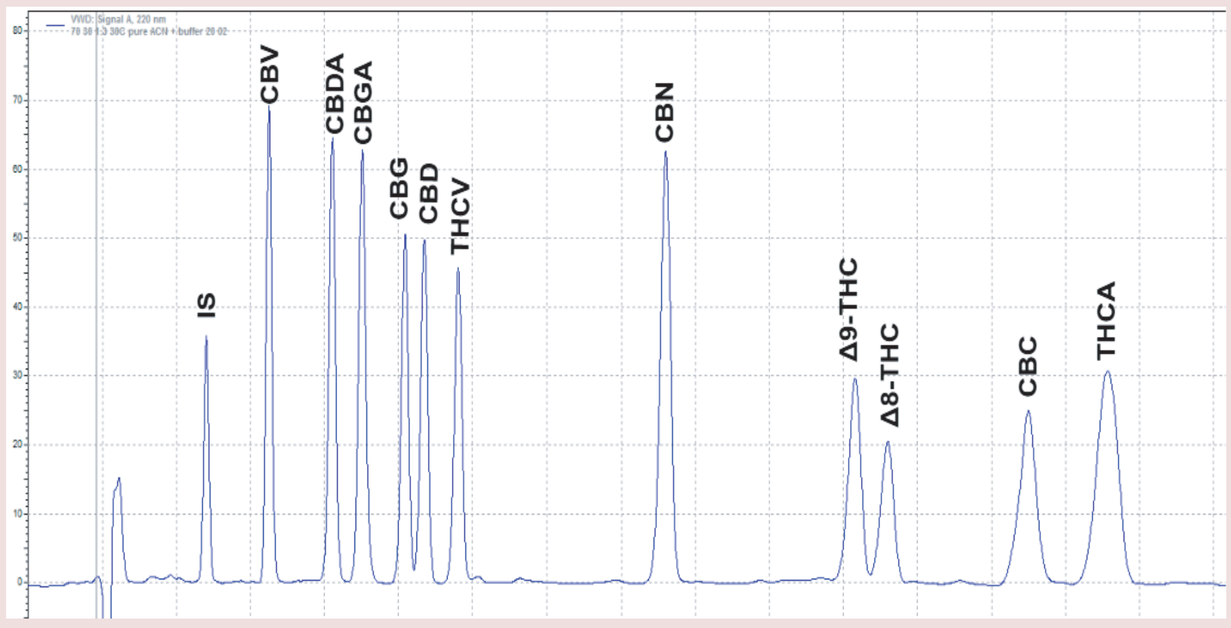

Figure 1: HPLC-UV Chromatogram of 11 cannabinoid separation at 220nm detection wavelength

RESULTS

The following challenges were identified during sample preparation, analysis, transport and storage (Table 1).

Table 1. Matrix-specific analytical challenges analytical impact, and corrective actions identified during cannabinoid analysis

Challenge	Matrix / source	Analytical impact	Corrective action
Matrix effect	Oils, cosmetics	Altered analyte response and reduced quantification accuracy	Matrix-matched calibration standards; internal standard used
Poor sample homogeneity	Creams, balms, plant material	Reduced repeatability and inconsistent extraction	Pre - homogenisation prior to sample preparation
Carryover	Medium - chain triglyceride (MCT) oil	Cross - contamination between injections and reduced run reliability	Acetonitrile wash run between analyses
Co-extraction of interfering compounds	Plant material	Waxes, chlorophylls and terpenes may compromise selectivity	Optimised sample preparation and extended cannabinoid panel
Certified reference material instability	Transport	Potential degradation during shipment	Express shipment with active tracking
Calibration solution instability	Storage	Reduced standard reliability over time	Storage at -20°C in amber glass vials

CONCLUSION

Analytical challenges influence cannabinoid quantification, indicating the need for matrix-specific sample preparation strategies and rigorously validated analytical methods to ensure accurate results across diverse product matrices. Future research should extend this analytical framework to include other formulations, such as edibles and vaping products, further contributing to consumer safety and product transparency.

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