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Short communication

Integration of morphological parameters in the assessment of microbiological quality of selected medical cannabis genotypes

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Introduction

The increasing medical application of cannabis has highlighted the imperative of ensuring reproducible product quality and stringent microbiological safety. As a botanical plant material, cannabis is inherently prone to microbial colonization, particularly by yeasts and filamentous fungi, which may pose clinically significant risks for patients, especially those with compromised immune systems (McKernan et al., 2016).

Recent evidence further indicates that cannabis may harbor mycotoxigenic fungi, including *Aspergillus* spp., capable of producing aflatoxins and other mycotoxins. Importantly, these toxic metabolites can persist even after decontamination treatments, underscoring a critical limitation of conventional microbial reduction strategies and representing an additional risk factor for patient safety (Rani et al., 2025).

The European Pharmacopoeia (Ph. Eur.) establishes microbiological quality standards aligned with Good Manufacturing Practice (GMP), including total aerobic microbial count (TAMC) and total yeast and mold count (TYMC) as key parameters. While these standardized assays provide a harmonized framework for microbial safety evaluation, their application to complex plant matrices such as cannabis may be influenced by intrinsic morphological and physicochemical characteristics (Punja et al., 2019).

Inflorescence morphology is a key factor influencing microbial quality, as differences in density, trichome distribution, and tissue compactness among genotypes can affect airflow and moisture retention, creating microenvironments conductive to microbial proliferation. However, this relationship remains insufficiently characterized, and the present study aimed to assess how inflorescence structure relates to microbiological quality in selected medical cannabis genotypes.

Materials and methods

Five medical cannabis genotypes were analyzed: *Tiger Milk (TM)*, *Red Pop (RP)*, *La Sage (LS)*, *Gelato (GE)* and *Apple and Bananas (AP)*. The samples exhibited distinct morphological traits, particularly in terms of inflorescences density and compactness. Based on visual assessment, samples

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were classified into two categories: compact inflorescence morphology (dense structure with limited inter-floral air spaces) and loosely structured inflorescence morphology (open structure with enhanced airflow).

Plant Material Classification

Genotypes were classified according to inflorescence architecture. Compact morphologies were defined by tightly packed structures with reduced inter-floral spacing, whereas loosely structured morphologies exhibited more open architectures with enhanced air circulation.

Microbiological Evaluation

Microbiological analysis was performed according to Ph. Eur. methods for non-sterile herbal products, assessing TAMC and TYMC under controlled laboratory conditions in compliance with standard quality assurance procedures.

Data Analysis

Results were interpreted in relation to morphological classification to evaluate potential correlations between flower structure and microbial contamination. Descriptive comparison was used to identify trends across genotypes.

Results and discussion

Microbiological quality varied among cannabis genotypes according to inflorescence morphology. Genotypes with compact inflorescences (*GE, TM*) exhibited higher TYMC and increased fungal susceptibility due to reduced airflow and increased moisture retention, while loosely structured inflorescences (*RP, AP*) had lower microbial loads as improved air circulation reduces moisture accumulation and limits microbial proliferation. The *LS* genotype exhibited intermediate values consistent with its morphology.

Punja et al. (2023) similarly report that elevated humidity and limited airflow within *Cannabis sativa* inflorescences promote fungal proliferation, whereas improved ventilation and moisture control reduce microbial contamination risk. These observations are particularly relevant for compact inflorescence morphologies, which may require stricter environmental control.

The results align with previous findings that plant architecture and environmental conditions influence microbial contamination in cannabis production systems (Punja et al., 2019). From a quality control perspective, these findings support incorporating morphological characteristics as an additional parameter in microbiological risk assessment within GMP frameworks.

Conclusion

This study demonstrates that inflorescence morphology is a key determinant of microbiological quality in medical cannabis, with compact structures associated with increased susceptibility to fungal contamination and loosely structured inflorescences linked to reduced microbial burden.

Integrating morphological parameters into microbiological quality assessment may improve risk evaluation and support more robust quality control strategies in GMP-regulated production. Further research is needed to refine this relationship and assess its application in routine quality assurance.

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