

PILOT-SCALE EXTRACTION OF PHENOLICS FROM DEFECTIVE GREEN COFFEE BEANS: FOOD SAFETY ASSESSMENT OF A FUNCTIONAL INGREDIENT

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Introduction

Defective and immature green coffee beans, commonly discarded during grading, offer potential for sustainable recovery of bioactive compounds such as phenolics.

Materials/Methods

Phenolic-rich extracts were obtained from *Coffea arabica* (cv. Catuaí vermelho, 2024/2025 harvest) beans presenting 1800 defects per 300 g (15% immature and 85% defective), sourced from Brascafé, Espírito Santo do Pinhal, Brazil.

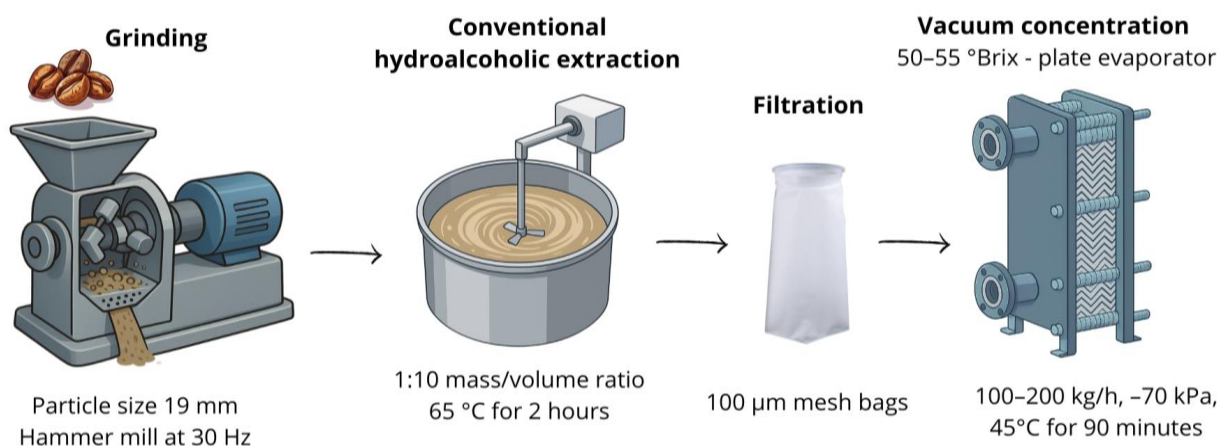


Figure 1: Phenolic-rich extracts from *Coffea arabica* obtained in the pilot scale of Centroflora Inova – Campinas (Brazil)

Comprehensive food safety assessment included pesticide residues, ochratoxin A, heavy metals, and microbiological quality. Pesticide residues were analyzed using the QuEChERS multiresidue method followed by GC-QqQ/MS/MS and LC-QqQ/MS/MS. A total of 303 active ingredients were screened, with quantification limits ranging from 0.001 to 0.05 mg/kg. Ochratoxin A was determined by HPLC with immunoaffinity column cleanup. The extract was analyzed for heavy metals (As, Cd, Pb, Hg) using ICP-MS and for microbial contaminants using validated methods: *Salmonella spp.* (AOAC 2003.09), *Escherichia coli* (ISO 16649), and molds and yeasts (APHA, 2015).

Results/Discussion

- ✓ No pesticide residues were detected in either the green beans or the extract.
- ✓ Ochratoxin A was quantified in the raw-unroasted coffee beans at 16.10 µg/kg.
- ✓ Heavy metals in the extract were all below the maximum permissible limits set by Brazilian legislation (Brasil, 2022).
- ✓ Microbiological results confirmed the absence of *Salmonella*, with *E. coli* below 10 CFU/g and molds and yeasts below 10² CFU/g.

Conclusion

These findings indicate that the pilot-scale extraction and concentration process are effective in producing a phenolic-rich ingredient that meets food-grade chemical and microbiological safety standards, supporting the safe upcycling of defective green coffee beans in sustainable food and beverage formulations.

References:

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