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Solid-State Fermentation of Corn Silk by *Aspergillus niger* Improves Phenolic Profile and Antioxidant Capacity

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INTRODUCTION & AIM

Corn silk (*Stigma maydis*) is a major residue of maize production, being mostly discarded despite its rich content of bioactive compounds. Given the growing interest in circular bioeconomy and sustainable food systems, biotechnological valorization of agricultural residues become a key strategy for generating functional ingredients.

Solid-state fermentation (SsF) using filamentous fungi such as *Aspergillus niger,* a GRAS microorganism with a broad enzymatic profile, can increase the release and biotransformation of bound phenolic compounds.

Thus, **the aim** of the present study was to evaluate the impact of *A. niger* SsF on the phenolic composition, antioxidant activity, and metabolic changes (organic acids, sugars) of corn silk, and to assess its potential as a value-added bioactive ingredient for food and nutraceutical applications.

METHODS & MATERIALS

- **Substrate:** Corn silk (Romanian origin)
- **Microorganism:** *A. niger* ATCC 6275
- **Fermentation:** 10-day solid-state process at 30 °C, 80% moisture, inoculum of 6 × 10^7 spores/g dw
- **Sampling:** Collected daily (CS_0–CS_{10})
- **Extraction:** Methanolic extracts prepared for phytochemical analysis
- **Analytical determinations:**
  - **Total phenolics (TPC):** Folin–Ciocalteu method (mg GAE/g dw)
  - **Total flavonoids (TFC):** $AlCl_3$ colorimetric method (mg QE/g dw)
  - **Phenolic profile:** LC-DAD–ESI–MS analysis
  - **Reducing sugars:** DNS assay
  - **Organic acids & saccharides:** HPLC-RID
  - **Antioxidant activity:** ABTS, DPPH, FRAP, and CUPRAC assays (mmol TE/g dw)
- **Statistics:** ANOVA with Tukey's HSD ($p < 0.05$, $n = 3$)

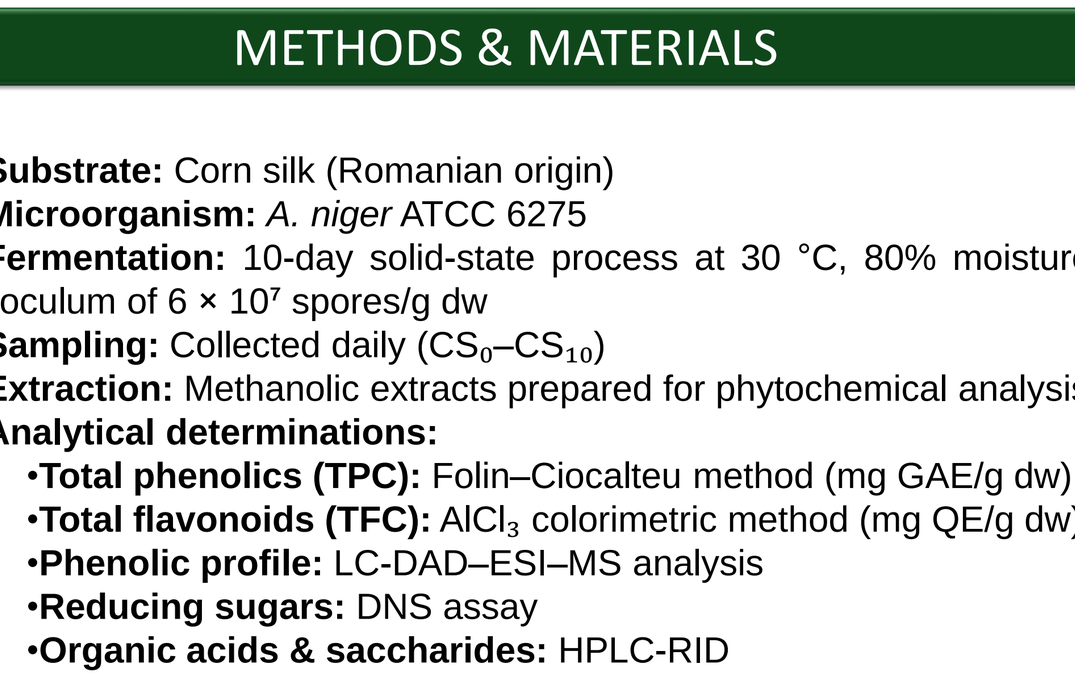

Figure 1. Experimental workflow for the solid-state fermentation (SsF) of corn silk with *Aspergillus niger* ATCC 6275 and subsequent analytical procedures, including antioxidant assays and HPLC-DAD-ESI-MS profiling of phenolic compounds.

RESULTS & DISCUSSION

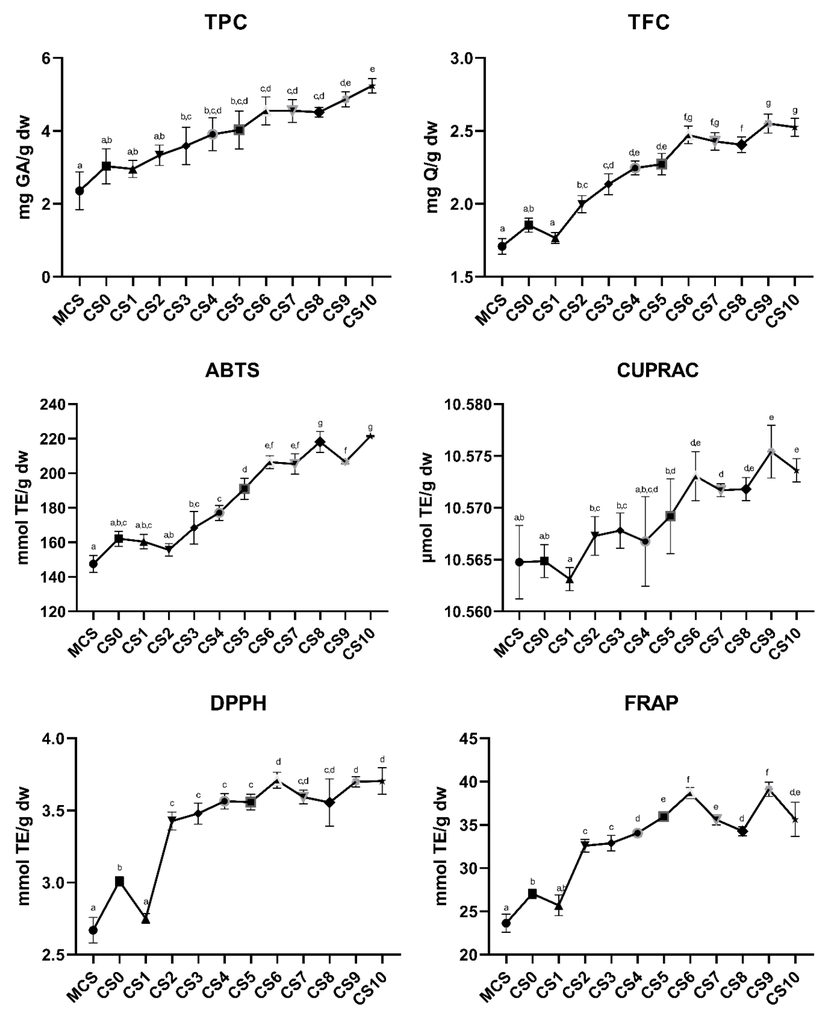

Figure 2. Variation in total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity (ABTS, CUPRAC, DPPH, and FRAP assays) of corn silk during 10-day solid-state fermentation (SsF) with *Aspergillus niger* ATCC 6275. Values represent mean ± SD ($n = 3$); different letters indicate significant differences ($p < 0.05$) among fermentation days.

Metabolite profiles:

- HPLC–MS identified increased levels of hydroxycinnamic acid derivatives (4-caffeoylquinic, 5-synapoylquinic, 4-feruloylquinic, and 3-synapoylquinic acids)
- Increased aglycone flavonoids indicated enzymatic deglycosylation
- Reducing sugars decreased, while organic acids (e.g., citric, malic) accumulated, confirming active fungal metabolism

These results indicated that *A. niger* enzymatic systems (cellulases, xylanases, pectinases, esterases) efficiently degraded the lignocellulosic matrix, liberating bound phenolics and improving bioactivity.

CONCLUSION

SSF with *A. niger* is an effective, low-cost, and sustainable approach for **increasing phenolic composition and antioxidant potential** of corn silk. Fermented corn silk may be a promising **functional ingredient** for functionalizing food development or nutraceutical applications, thus supporting **circular bioeconomy principles**.

REFERENCE

Frumuzachi, O., Nicolescu, A., Martău, G.-A., Odocheanu, R., Ranga, F., Mocan, A., & Vodnar, D. C. (2025). Enhancing the phenolic profile and antioxidant activity in corn silk via solid-state fermentation with *Aspergillus niger*. *Innovative Food Science & Emerging Technologies*, 105, 1-15.