

**INTENSIFICATION OF VIOLACEIN PRODUCTION FROM AGRO-INDUSTRIAL
BY-PRODUCTS USING SOLID-STATE FERMENTATION BY
*JANTHINOBACTERIUM LIVIDUM***

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<https://doi.org/10.52757/bsd26.57>

Background: The accumulation of agro-industrial residues is a major environmental and economic challenge, encouraging sustainable bioprocesses for their conversion into high-value products. Solid-state fermentation (SSF) is a promising strategy due to low water use, reduced energy demand, and high substrate compatibility. In this context, violacein, a bisindole-derived purple pigment produced by several bacterial species, has gained interest because of its broad biological activities, including antimicrobial, antitumor, and immunomodulatory effects. However, its industrial application remains limited by low production yields under conventional submerged fermentation conditions.

Aim of the study: This study aimed to evaluate the potential of diverse agro-industrial by-products as low-cost substrates for violacein production by *Janthinobacterium lividum* under SSF conditions, and to optimize key process parameters to maximize production efficiency.

Materials and methods: A range of lignocellulosic and protein-rich residues, including hemp seed cake, grape marc, coffee grounds, brewers' spent grains, wheat bran, date pits, sunflower seed cake, and rapeseed cake, were screened as fermentation substrates. Their biochemical composition was determined by standard methods: Kjeldahl for protein, Soxhlet for lipids, AOAC for moisture and ash, and Folin-Ciocalteu for total phenolics. SSF experiments were performed under controlled conditions (70% initial moisture, 25 °C, 24 h inoculum age, 7 days fermentation). Parameters affecting violacein biosynthesis (moisture, inoculum volume, temperature) were optimized using a Box-Behnken design and response surface methodology to assess factor interactions and identify optimal conditions.

Results: Substrate characterization showed marked compositional variability: hemp seed cake had the highest protein and lipid contents, while date pits had the highest total phenolic content (14.63 g GAE/100 g). Among the tested substrates, hemp seed cake provided the best conditions for bacterial growth and violacein biosynthesis. Optimization identified 25 °C, 4 mL inoculum, and 80% moisture as optimal parameters, yielding 0.99 mg/g dry matter after 7 days of fermentation. This was a significant improvement over non-optimized conditions, confirming the efficiency of the applied strategy.

Conclusions: This study demonstrates that agro-industrial by-products, especially hemp seed cake, are efficient and sustainable substrates for violacein production by SSF. The findings support integrated waste valorization processes and the transition toward a circular bioeconomy through coupling residue management with high-value bioactive compound production

Keywords: solid-state fermentation, violacein, *Janthinobacterium lividum*, agro-industrial residues, process optimization.

Acknowledgments: Communauté Urbaine du Grand Reims, Département de la Marne, Region Grand Est and European Union (FEDER Champagne-Ardenne 2014-2020, FEDER Grand Est 2021-2027) are acknowledged for their financial support to the Chair of Biotechnology of Centrale Supélec and CEBB.