Patent

Process for preparing a vinylphenolic compound from a precursor hydroxycinnamic acid derived from an oilseed cake

OLEOCHAMPI

Patent FR1560393 –
Publication WO2017072450

Oilseeds – Oilseed meals – Canolol – Biocatalysis – Decarboxylase

INNOVATION INRAE

INRAE transfert

#InnoverAvecINRAE

CARNOT 3BCAR

Terres Inovia
l'agronomie en mouvement

Terres Univia
l'Interprofession des huiles et protéines végétales

October 2025 edition

Process for preparing a vinylphenolic compound from a precursor hydroxycinnamic acid derived from an oilseed cake

Context

Oilseed meals (rapeseed, sunflower, soybean) are abundant by-products with limited valorization after oil extraction. These residues contain hydroxycinnamic acids (sinapic, caffeic, ferulic, p-coumaric) bound to the matrix, which can serve as precursors for vinylphenolic compounds (e.g., canolol, 4-vinylguaiacol) recognized for their antioxidant, aromatic, and protective properties.

Current chemical processes for producing these compounds require harsh conditions, achieve low yields, and do not allow for the direct valorization of raw feedstocks. The proposed process relies on a mild, biosourced biocatalytic approach, using specific enzymes to convert raw oilseed meal into high-value functional molecules.

Description

The process described in the patent family is a two-step biocatalytic procedure that converts hydroxycinnamic acids present in oilseed meals into high-value vinylphenolic compounds (e.g., **sinapic** → **canolol**, ferulic → 4-vinylguaiacol, p-coumaric → 4-vinylphenol).

The approach combines: (A) an enzymatic release of the acids bound to the meal matrix, followed by (B) an enzymatic decarboxylation forming the vinylphenolic product. The process is designed to operate under mild conditions, without the need for harsh thermal or chemical treatments.

Results obtained

The work leading to the patent filing enabled to:

- Isolate and characterize a *Phenolic Acid Decarboxylase* (PAD) from the fungus *Neolentinus lepideus*, capable of efficiently **decarboxylating** various hydroxycinnamic acids, **in particular sinapic acid**
- Develop a two-step process:
  1. Enzymatic release of p-hydroxycinnamic acids from the meal using esterases (notably from *Aspergillus niger*)
  2. Non-oxidative enzymatic decarboxylation of these acids into vinylphenols
- Achieve high yields: **up to 70–75% conversion of sinapic acid into canolol**
- Directly valorize an agricultural by-product, without harsh chemical extraction
- Demonstrate enzyme stability and selectivity under mild industrial conditions (neutral to slightly acidic pH, moderate temperature)

These results validate the feasibility of a process that can be integrated into an agro-industrial valorization chain.

The novelty of this technology lies in the **production of canolol**, a vinylphenolic compound naturally absent from the market, with strong potential as an antioxidant and functional ingredient.

#InnoverAvecINRAE

CONTACT

INRAE Transfert – Stéphanie LEMAIRE
Technology Transfer Officer "Bioeconomy & Bioprocesses"
stephanie.lemaire@inrae.fr - +33 (0)6 24 03 86 53

Laboratory & Principal Investigator

Anne Lomascolo – Associate professor HDR
anne.lomascolo@univ-amu.fr
UMR 1163 – Biodiversité & Biotechnologie Fongiques

Process for preparing a vinylphenolic compound from a precursor hydroxycinnamic acid derived from an oilseed cake

Scientific and technological impact

- **Enzymatic innovation:** identification of a new, high-performance fungal PAD for the bioconversion of cinnamic acids, **exhibiting novel activity on sinapic acid**
- **Green chemistry advancement:** enzymatic substitution of chemical methods, energy-efficient and solvent-free
- **By-product valorization:** integration into circular bioeconomy and sustainable processing of oilseed meals
- **Creation of proprietary know-how:** combination of two enzymatic steps (hydrolysis + decarboxylation) in an integrated process
- **Patent protection:** international patent covering the process, enzymes, and operating conditions

Advantages

- **Biosourced and sustainable process:** use of an agricultural by-product, reduction of chemical inputs
- **Mild and selective process:** no extreme conditions or costly cofactors, excellent purity of the final product
- **Economic valorization of meals:** conversion of a low-value by-product into high-value molecules
- **Efficient and specific enzymes:** high yields and adaptability to different substrates (rapeseed, sunflower, soybean…)
- **Industrial compatibility:** can be integrated into vegetable oil extraction lines or natural ingredient production processes

CONTACT

INRAE Transfert – Stéphanie LEMAIRE
Technology Transfer Officer "Bioeconomy & Bioprocesses"
stephanie.lemaire@inrae.fr - +33 (0)6 24 03 86 53

Potential applications

- **Food industry:** natural antioxidants for oil stabilization, clove- or smoky-type flavors (4-vinylguaiacol)
- **Cosmetics:** antioxidant active ingredients for protective and anti-aging formulations
- **Green chemistry:** bio-based intermediates for polymers or functional additives
- **Agro-industry / biotechnology:** integrated valorization of oilseed meals in crushing units and biorefinery processes

Transfer opportunities

- Technology transfer via patent licensing (exclusive or non-exclusive, depending on application and territory), including know-how and enzymatic protocol
- Industrial co-development for adaptation of the process to a specific oilseed meal stream and pilot-scale upscaling

The co-owners are seeking an industrial partner willing to carry the development to pilot scale and market deployment.

Development stage

1 2 3 **4** **5** 6 7 8 9

Current TRL: 4–5 – proof of concept completed, yields validated in the laboratory, **initial tests conducted in small-scale reactors (a few liters)**

Next steps:

- Optimization of enzyme production and coupling of the two reactions
- Pilot-scale validation (10–50 L)
- Techno-economic and environmental assessment of the process
- Application testing on target matrices (food, cosmetics, chemical industry)

An industrial partnership is sought for scale-up and commercial valorization of the process.

Laboratory & Principal Investigator

Anne Lomascolo – Associate professor HDR
anne.lomascolo@univ-amu.fr
UMR 1163 – Biodiversité & Biotechnologie Fongiques