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Molecularly imprinted polymers for the removal of iprodione from wine: experimental design and synthesis optimization
M. Bitar, E. Bou-Maroun, P. Cayot

Introduction

Substantial evidence demonstrates the potential for transfer of fungicides during the winemaking process. In order to remove these fungicides from wine samples, molecularly imprinted polymers (MIP) have been prepared and tested in a hydro-alcoholic solution containing iprodione. Iprodione was chosen as fungicide because it was detected in more than 90% of the French wine according to a survey done by the French ministry of agriculture [1].

Materials and methods

1- Synthesis

**Iprodione-MIPS’ non-covalent synthesis**

- **Template**
  - Iprodione
- **Porogen solvent**
  - Toluene
- **Initiator**
  - 2,2-dimethoxy-2-phenyl acetoephone (DMAPAP)

2nd factorial experimental design

- **Factor 1**
  - Functional Monomer (FM) (crosslinker)
  - +1 Methacrylamide
  - +1 Methacrylamide + styrene
- **Factor 2**
  - Crosslinker (C)
  - +1 Trimethylolpropane trimethacrylate (TRIM)
  - + Ethylene glycol trimethacrylate (EGDMA)
- **Factor 3**
  - Polymerization method (PM)
  - +1 Monolith
  - +1 Precipitation

2- Template removal

- Acetic acid/ethanol + ultrasonication

3- NIPs synthesis

8 NIPs were synthesized in a similar manner without template

4- Binding experiments

- **Iprodione solutions**
  - 20 mL ethanol/water
  - \(10^{-3} \text{M} < [\text{iprodione}] < 10^{-1} \text{M}\)
  - 10 mg polymer
  - 25°C

- **Extraction**
  - Batch extraction
  - Magnetic stirring

Freundlich isotherms

Fig. 3 : Freundlich isotherms exempla MIPs and NIPs.

HPLC

- C18 stationary phase
- Acetonitrile/water (60/40)
- Mobile phase
- UV detection

5- Response variables

- \(B = a F^m\)
- \(B : \text{binded iprodione}\)
- \(F : \text{free iprodione}\)
- \(a, m : \text{Freundlich parameters}\)

Results

<table>
<thead>
<tr>
<th>Table 1 : full experimental design</th>
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<tbody>
<tr>
<td>MIP</td>
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The optimal MIP : MIP5

- F1 : precipitation
- F2 : TRIM
- F3 : methacrylamide

The addition of styrene decreases the apparent affinity and the sites number.

Conclusion

The use of TRIM increases the apparent affinity and \(K(MIP)/K(NIP)\).

The precipitation polymerization increases the apparent affinity and the sites number.