Supplementary Information (SI) for Sustainable Food Technology.
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SUPPLEMENTARY INFORMATION

Biorefining of crab shells for protein recovery using Natural Deep Eutectic Solvents: Physicochemical and functional characterization of crab shell proteins

Tharuka Wijesekara[1], Idaresit Ekaette[1,2*]

[1] Department of Food Science and Agricultural Chemistry, McGill University, Ste-Anne-de-Bellevue, Quebec, Canada H9X 3V9.

[2] Department of Bioresource Engineering, McGill University, Ste-Anne-de-Bellevue, Quebec, Canada H9X 3V9.

Corresponding author: Idaresit.ekaette@mcgill.ca

Assumptions used for cost estimation

The NADES systems used in this study included ChCl-lactic acid and ChCl-glycerol (1:2 ratio) as well as ChCl-malic acid and ChCl-malonic acid (1:1 ratio). Based on laboratory-scale chemical prices, the estimated costs were approximately $117/kg (ChCl-glycerol), $175/kg (ChCl-lactic acid), $167/kg (ChCl-malic acid), and $340/kg (ChCl-malonic acid), with an average cost of about $200/kg.

- NADES preparation basis: 1 kg total solvent
- Recovery efficiency: 90% (only 10% required per cycle)
- Ratios:
    - ChCl:Lactic acid (1:2)
    - ChCl:Glycerol (1:2)
    - ChCl:Malic acid (1:1)
    - ChCl:Malonic acid (1:1)
- Raw material prices
    - Choline chloride = $240/kg
    - Lactic acid = $71 per 500 g = $142/kg
    - Glycerol = $55/kg
    - Malic acid = $47 per 500 g = $94/kg
    - Malonic acid = $220 per 500 g = $440/kg
- Crab shells = $0 (waste material)

Rough NADES Cost Estimate (per 1 kg solvent)

NADES system	Ratio	Composition for 1 kg	Cost without recovery ($)	Cost per cycle with 90% recovery ($)
ChCl–Lactic acid	1:2	ChCl 0.333 + Lactic acid 0.667	(0.333×240) + (0.667×142) = $174.7	$17.5
ChCl–Glycerol	1:2	ChCl 0.333 + Glycerol 0.667	(0.333×240) + (0.667×55) = $116.7	$11.7
ChCl–Malic acid	1:1	ChCl 0.5 + Malic acid 0.5	(0.5×240) + (0.5×94) = $167.0	$16.7
ChCl–Malonic acid	1:1	ChCl 0.5 + Malonic acid 0.5	(0.5×240) + (0.5×440) = $340.0	$34.0