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Enzymatic hydrolysis for the removal of 3- monochloropropanediol esters in edible oils using *Candida rugosa* lipase in the presence of deep eutectic solvents and nanocellulose

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Abstract

3-monochloropropanediol ester (3-MCPDE) is identified as a food-borne contaminant in edible oils and are classified as a possible carcinogen. This study reports an efficient enzymatic technique for the removal of 3-MCPDE from extra virgin olive oil (EVO) using *Candida rugosa* lipase (CRL) as the biocatalyst in the presence of choline chloride and fructose-based natural deep eutectic solvent (NADES) and nanocellulose (NC) extracted from almond shells. The validity of the method was confirmed by gas chromatography mass spectrometry (GC-MS) showing adequate precision with relative standard deviation values $\leq 2.37\%$. The quantification and detection limit are within the permissible levels of 3-MCPD in edible oils. Under optimized conditions of 30 min at 90 °C with 60 μ L of phenylboronic acid (PBA), the enzymatic hydrolysis resulted in the removal of 79.8% of spiked 3-MCPD in EVO. No adverse effects of the EVO were detected from this technique with respect to the oil quality testing. The application of DESs and NCs as the support material for the CRL biocatalyst for the removal of 3-MCPDE has yet to be explored. This could have a significant impact on the edible oil industry for producing oils of higher quality free from 3-MCPDE. © 2023 Elsevier B.V.

Author Keywords

3-Monochloropropanediol ester; Enzymatic hydrolysis; Lipase; Nanocellulose; Natural deep eutectic solvents

Index Keywords

Candida, Chlorine compounds, Esters, Eutectics, Fermentation, Gas chromatography, Lipases, Liquid chromatography, Mass spectrometry, Nanocellulose, Olive oil, Pesticides, Solvents, Yeast; 3-monochloropropanediol ester, Almond shells, *Candida rugosa* lipase, Choline chloride, Classifieds, Deep eutectic solvents, Extra-virgin olive oil, Gas chromatography-mass spectrometry, Nano-cellulose, Natural deep eutectic solvent; Enzymatic hydrolysis; 3 monochloropropanediol ester, acid, benzenboronic acid, choline, deep eutectic solvent, extra virgin olive oil, fatty acid, fructose, fungal enzyme, nanocellulose, peroxide, propanediol derivative, triacylglycerol lipase, unclassified drug; accuracy, almond, Article, Brunauer Emmett Teller method, *Candida rugosa*, chemical composition, controlled study, enzymatic hydrolysis, enzyme immobilization, esterification, Fourier transform infrared spectroscopy, limit of detection, limit of quantitation, mass fragmentography, maximum permissible dose, nonhuman, physisorption, reaction time, saponification, surface area, X ray photoemission spectroscopy

Chemicals/CAS

benzenboronic acid, 98-80-6; choline, 123-41-1, 13232-47-8, 1927-06-6, 4858-96-2, 62-49-7, 67-48-1; fructose, 30237-26-4, 57-48-7, 7660-25-5, 77907-44-9; peroxide, 14915-07-2; triacylglycerol lipase, 9001-62-1

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