AQUEOUS ENZYME ASSISTED OIL EXTRACTION FROM OILSEEDS BY USING PAPAIN-COATED MAGNETIC MICROPARTICLES

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RATIONALE: Nowadays, the technology used to produce oil from oilseeds is based on the extraction in organic solvents or on the use of high pressures. Safety and environmental issues have prompted the development of aqueous enzymatic extraction for oil recovery from oilseeds. Moreover, enzyme immobilization is a versatile tool in biotechnological processes to enhance enzyme activity and reusability.

OBJECTIVES: Given these assumptions, the main objective of this study was the development of an immobilized-enzyme system able to improve both extractability and yield of oil from oilseed. Papain-coated magnetic microparticles were developed and used as a biotechnological tool with low environmental impact and economically profitable, to extract oil from oilseed.

METHODS: Magnetic particles of Fe_3O_4 were synthesized with Fe(II) and Fe(III) (Tan et al. 2015). Papain, a serine-proteases, was covalent bonded to magnetic microparticles (Fe3O4) previously coated with dialdehyde starch (DAS) and used for the oil extraction. The samples were prepared grinding the oilseeds, properly incubated with the enzyme (50°C 150 rpm overnight) and then centrifuged at 4000 rpm for 30 min to separate oil from the solution. Moreover, the optimal condition was evaluated, such as the temperature, the pH and the buffer solution, nonetheless the kinetics.

RESULTS: The microparticles directly coated with papain losing all the enzymatic activity after one washing assuming no covalent linking between particles and enzyme. By coat magnetic nanoparticles with DAS papain was covalently bounded with a yield of immobilization of over 50% moreover, an increase on the enzyme stability was observed with a consequently improvement of the enzyme reuse. The best condition for the enzyme activity was evaluated as follow buffer TRIS-HCl 50 mM containing cysteine 5 mM and EDTA 2 mM at pH 8.0 and 50°C. Additionally, the reuse of the immobilized enzyme allows a considerable saving on the quantity of enzyme used, in fact up to 4 times of reuse the coated enzyme activity decreased by less than 10%. Finally, immobilized enzyme was tested on different raw materials, such as pumpkin seeds and walnuts. In both samples the immobilized enzyme aids in aqueous-assisted oil extraction showing an increase on the yield of extraction. In particular, the oil yield increases, compared to the normal aqueous oil extraction, both in walnuts and pumpkin seeds, respectively of 40% and 20%.

CONCLUSIONS: This study demonstrated that the papain-coated magnetic nanoparticle allows to extract oil from oilseeds, avoiding the use of solvents or high pressures and improving the process in terms of yield. Moreover, with a view to a circular economy, the possibility to recovery the papain-coated magnetic microparticles through a magnet, allow to reuse the enzyme reducing the process cost.

REFERENCE

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