Waste Biomaterials for Green Engineering

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In the search for environmentally benign alternatives to chemical synthesis, enzymatic synthesis has come to the forefront. Unfortunately, the enzymatic synthesis is often not applied for larger scale processes due to the high cost of purified enzyme, such as peroxidase, coupled with requirements for fairly large quantities. In addition, many of these reactions are still carried out in volatile organic solvents, which are less than attractive for environmental sustainability. If waste biomaterials can be used as the source of the enzyme, however, the costs could be substantially reduced. This coupled with the use of aqueous or ionic liquid solvents for would lead to more cost-effective and environmentally appropriate chemical synthesis for necessary compounds.

We have evaluated the activity and stability of horseradish peroxidase (HRP) extracted from horseradish food processing waste using both water immiscible and water miscible ionic liquids. The water content of the solvent systems ranged from water-free to 25% water by volume in aqueous buffer (pH 7.4). Control solvents consisted of aqueous buffer and the organic solvents dioxane and tert-butanol. The extracted peroxidase enzyme exhibited high activity and stability in the halogenated ionic solvents [(OMIM)] [Cl] and [4MBP] [BF₄]. The sulfate-based ionic liquids [(eMIM)] [MeSO₄] and [(eMIM)] [EtSO₄] exhibited lower activities, suggesting enzyme deactivation via sulfide ion inhibition or some other mechanism. The loss of activity resulting from the action of the ionic liquids is partially reversible via aqueous buffer dilution.

The evaluation of the waste-based enzyme activity and stability is the first step in the development of green reactor systems for product synthesis.

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