Efficient degradation of Carbamazepine (CBZ) from the waste water using combined effect of immobilized laccase and ultrasound

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Introduction: Carbamazepine(CBZ) is an antiepileptic drug having impact on aquatic life and associated health risks when excreted in unaltered form due to inefficient degradation by conventional waste water treatment methods. It can be efficiently degraded using biocatalytic approach.

Methodology: Combined approach of Biocatalysis and Cavitation

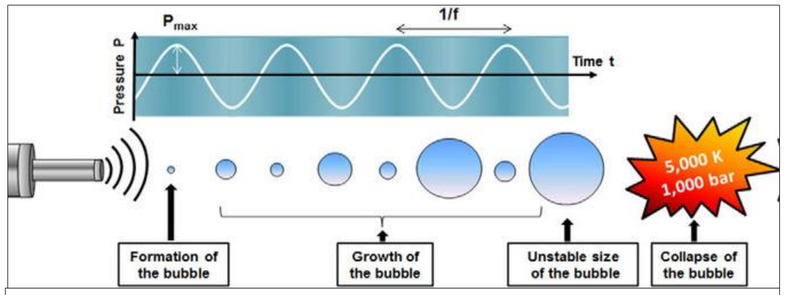
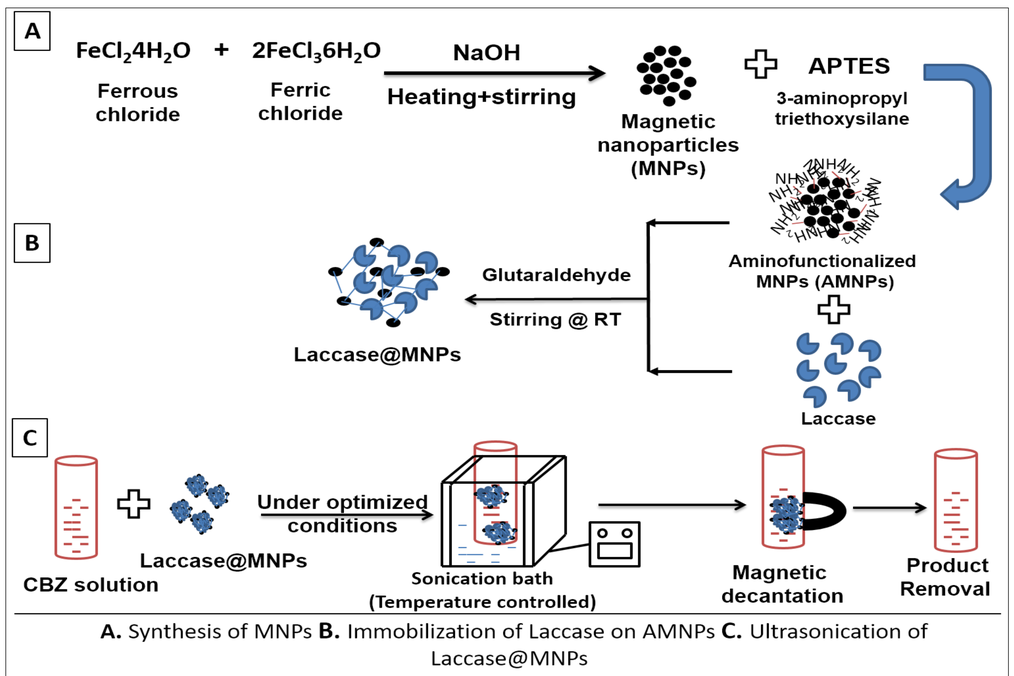


Fig. 1. Cavitation phenomenon



A. Synthesis of MNPs **B.** Immobilization of Laccase on AMNPs **C.** Ultrasonication of Laccase@MNPs

Fig. 2. Schematic of the process

- **Optimized parameters for immobilization process for maximum enzyme activity:** 1:3 MNPs:Enzyme; 10mM cross linker concentration; 60 min cross linking time.

Characterization of Nano-biocatalyst:

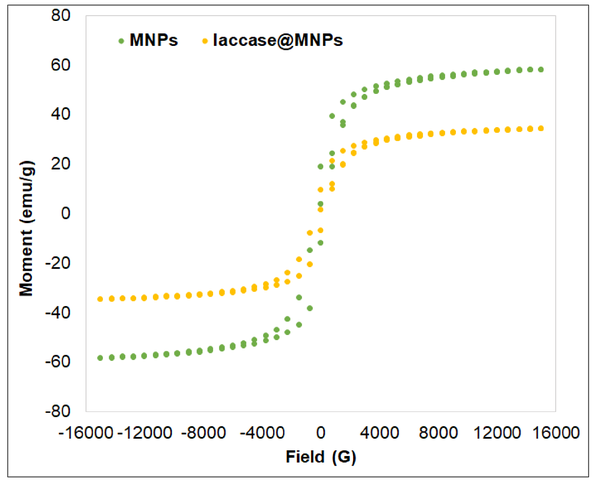


Fig. 3. VSM analysis of bare MNPs and immobilized enzymes@MNPs

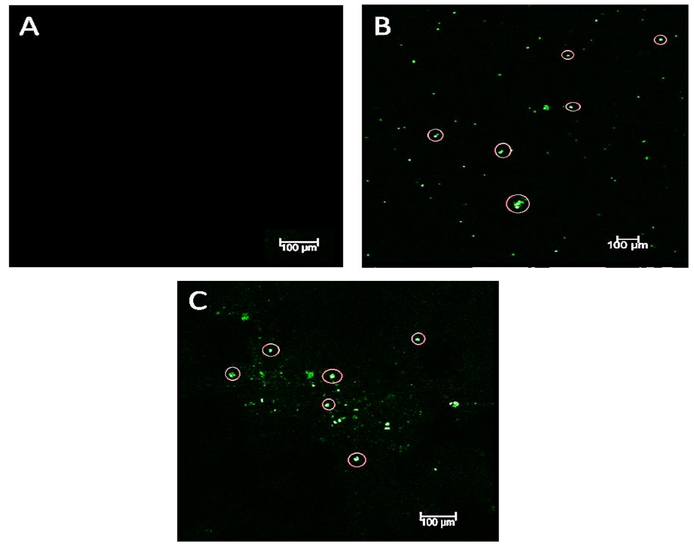


Fig. 4. CLSM of FITC labeled MNPs (A); AMNPs (B); laccase@AMNPs (C)

Optimization of Sonication parameters:

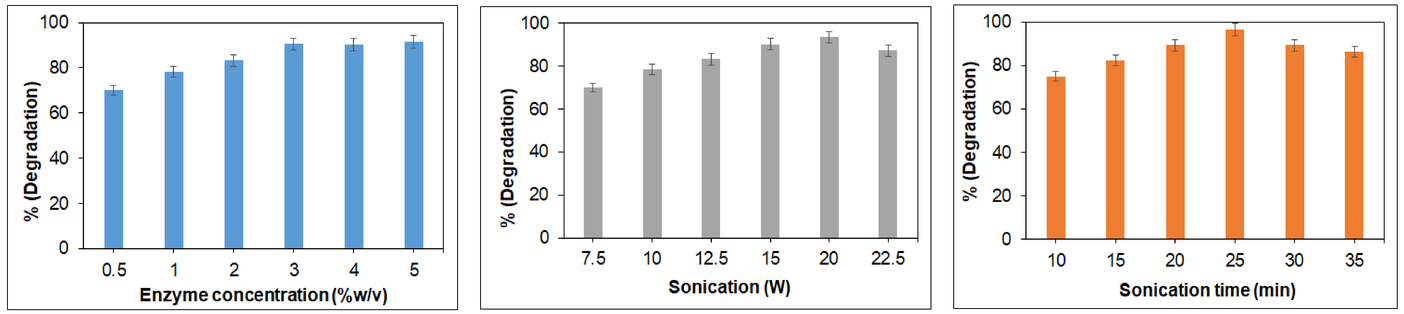


Fig. 5. Optimization of different sonication conditions for maximum degradation of CBZ from waste water

Results and Discussions:

Only enzymatic treatment	• CBZ Degradation = **82±0.5%**
Only sonication	• CBZ Degradation = **78±2%**
Combined effect	• CBZ Degradation = **96±0.8%**

Conclusions:

- ✓ The laccase immobilized MNPs (laccase@AMNPs) were synthesized using a facile approach.
- ✓ The thermal stability and catalytic activity of the prepared biocatalyst showed remarkable improvement.
- ✓ The laccase@MNPs showed an excellent reusability and storage stability.

References: [1] M. Primožič., G. Kravanja., Ž. Knez., A. Crnjac., & M. Leitgeb. (2020). Immobilized laccase in the form of (magnetic) cross-linked enzyme aggregates for sustainable diclofenac (bio) degradation. Journal of Cleaner Production, 275, 124121.

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