

Accepted Manuscript

Title: The novel multi cross-linked enzyme aggregates of protease, lipase, and catalase production from the sunflower seeds, characterization and application

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PII: S0927-7765(18)30653-2
DOI: <https://doi.org/10.1016/j.colsurfb.2018.09.042>
Reference: COLSUB 9645

To appear in: *Colloids and Surfaces B: Biointerfaces*

Received date: 16-11-2017
Revised date: 18-9-2018
Accepted date: 19-9-2018

Please cite this article as: Özacar M, Mehde AA, Mehdi WA, Özacar Z, Severgün O, The novel multi cross-linked enzyme aggregates of protease, lipase, and catalase production from the sunflower seeds, characterization and application, *Colloids and Surfaces B: Biointerfaces* (2018), <https://doi.org/10.1016/j.colsurfb.2018.09.042>

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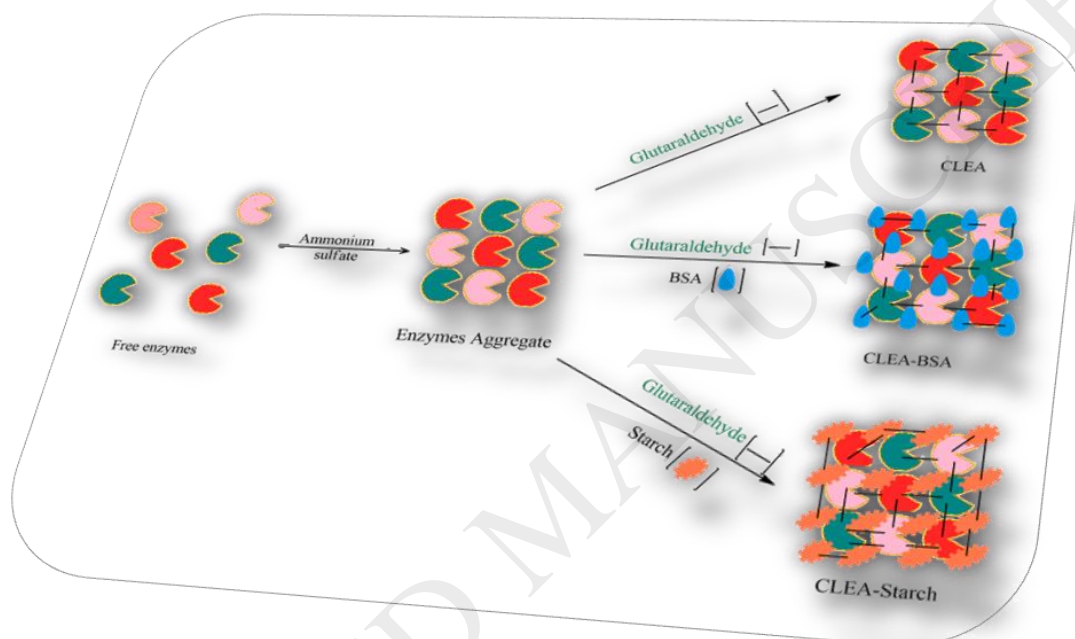
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Graphical Abstract



The Highlights

- A simple, efficient cross-linking method for multi-enzymes was developed.
- Novel method of preparation of multi-CLEAs-starch was developed.
- Multi-CLEAs-starch had high initial activity and operational stability.
- A significant role of multi-CLEAs in environmental biotechnology.

ABSTRACT

The cross-linked enzyme aggregates (CLEAs) have numerous economic advantages in the industrial bio catalysis. In the present study, the multi CLEAs containing protease, catalase, and lipase from the sunflower seeds using starch as a cofeeder as well as bovine serum albumin (BSA) are designed and prepared successfully. After optimization, multi CLEAs of enzyme have been prepared with ammonium sulfate (55% w/v), glutaraldehyde (100 mM), and 8 mg/mL of starch or 20 mg/mL of BSA. The activity recovery of protease, catalase, and lipase multi CLEAs-starch are 87, 61, and 60%, respectively. Whereas, CLEAs prepared with BSA are 74, 61, and 50% activity and multi CLEAs only 60, 44, and 41% of protease, catalase, and

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