

Abstract

The thesis encompasses a detailed study of the detection of acrylamide in various Indian food products. The study focused on acrylamide and various mitigation strategies viz. enzymatic and non-enzymatic, employed for acrylamide reduction in food systems, while the later studies more focused on acrylamide degradation using amidase enzymes. The work features the development of the chemosensor for rapid detection of acrylamide in food samples.

To address the challenges of quantification of acrylamide in Indian food products (fried and baked), the extraction and determination of acrylamide was established. The detection reported a high level of acrylamide in heat-processed food products through HPLC. Further, the non-enzymatic strategies involving natural antioxidant compounds resulted in the alleviation of acrylamide content in food systems. In vitro, testing of cinnamyl alcohol on acrylamide formation revealed that there was an 83.3% reduction in the formation. Furthermore, the antioxidant compounds present in guava leaves extracts were also employed in frying oils for mitigation of acrylamide formation in Indian staple food (poori). The antioxidant compounds present in guava extracts inhibited the formation of acrylamide by up to 27%.

Moreover, the work intended to explore the enzymatic strategies using microbial L-asparaginases and their immobilized preparation as a pre-treatment method for acrylamide reduction in food systems. The L-asparaginase from two microbial sources, *Bacillus aryabhatai* and *E. coli* was employed for immobilization on functionalized magnetic nanoparticles. The L-asparaginase from *Bacillus aryabhatai* demonstrated a >90% reduction of acrylamide in the starch-asparagine food model system, whereas *E. coli* L-asparaginase resulted in a >95% reduction in fried potato chips. These findings highlight the prospects of cost-effective, thermostable, and immobilized L-asparaginase as promising candidates for food processing applications.

Subsequently, the potential of amidase enzymes was also explored. A newly amidase-producing bacterial strain was isolated using a soil enrichment technique, and its enzymes were purified and studied in detail. The genomic insights highlighted by whole genome sequencing, along with biochemical, structural, and kinetic characterization, were elucidated to decipher the catalytic mechanism of amidases. The comprehensive study was further conducted on the recombinant amidase that holds tremendous applications in acrylamide degradation.

As an innovative part of the thesis, the chemosensor was developed by exploiting the DTT and gold nanoparticles. The study features a new and elegant approach to the detection of acrylamide in food systems. The novelty in the present work relates to the method of synthesis, the designing of the product, and the process optimization to get the desired features. Rapid and simple electroanalysis of acrylamide was feasible by enhanced detection sensitivity and selectivity. The limit of detection (LOD) and the limit of quantitation (LOQ) were estimated to be 3.11×10^{-9} M and 1×10^{-8} M, respectively, with wide linearity ranging from 1×10^{-8} M to 1×10^{-3} M. The estimated levels of acrylamide in both the cases, potato chips and coffee samples by the sensor were in agreement with those of high-performance liquid chromatography. These findings point towards effective, sensitive, and accurate quantification of acrylamide via chemosensor electroanalyses.