The Development of Lactase Hydrogel to Alleviate Lactose Intolerance from Dairy Beverages

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Dairy beverages contain a rich source of nutrients including vitamins, calcium which is essential for growth and disease prevention. Lactose intolerance hinders 65% of the world population from gaining these health benefits due to the intestinal deficiency of lactase. By utilizing the crosslinking mechanism of calcium alginate to immobilize lactase, we hypothesized that the lactase hydrogel can alleviate lactose intolerance through hydrolysis of lactose in dairy beverages. A calibration curve was created by relating absorbance values obtained from R components of glucose oxidase reagent strips to known glucose concentrations, from which the corresponding lactose concentrations were calculated. The versatility of our immobilized lactase hydrogel was tested by examining the effects of pH, temperature, and types of dairy beverages on the rate of hydrolysis of lactose. To maximize reusability and prolong shelf life, chitosan-based coatings were added of which their antimicrobial activities were investigated by disc diffusion method. Results show that the lactase hydrogel can efficiently hydrolyze lactose in milk within pH 3-8 and 4°C-75°C. The time for complete hydrolysis of lactose in dairy beverages ranges from 12 to 25 minutes due to the differences in contents of protein, cofactors, and additives. The lactase hydrogel can be used in fresh milk for at least 18 successive hydrolysis cycles while retaining 75% of the initial enzymatic activity. Chitosan/thyme oil coating was applied as it shows the largest inhibition zone diameter of against Gram-positive and Gram-negative bacteria respectively. In conclusion, lactase hydrogel is a promising solution to make dairy beverages accessible to all.

Awards Won:
American Chemical Society: Certificate of Honorable Mention