Model Validation and Preclinical Testing of Digestive Enzymes for Gluten Breakdown: A Move to Cure Gluten Intolerance and Celiac Disease

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Three million people in the U.S. suffer from gluten intolerance/celiac disease (CD). In these patients, the digestive system cannot digest gluten proteins. My project aims to solve this issue. In previous research, I identified three fruit enzymes that synergistically break down gluten when combined in a 1:2:3 ratio of Papain:Bromelain:Actindin respectively (will be referred to as 1-2-3 EC MIX). Based on this previous finding, I proposed two models of how the enzymes act together to degrade the gluten molecule. This year, I performed quantitative studies to validate the two models proposed. I used model gliadin peptides that are most immunogenic in CD patients to see a) to what extent does my 1-2-3 EC MIX degrade these immunogenic strong peptides and b) will it inhibit reactive T cell stimulation? Immunogenic 33 mer peptides and gliadins were incubated with 1-2-3 EC MIX in different pH conditions and tested using LS/MS mass spectrometry, G12 ELISA, gel electrophoresis, and cytokine assays. The results are below: 1) 1-2-3 EC MIX significantly degraded gliadin at pH=6 and acidic pH 2-3 compared to sequential addition of the three enzymes 2) 1-2-3 EC MIX is stable and functional in the stomach acidic environment overcoming a major challenge in oral drug delivery 3) Pretreatment of gliadin peptides with my 1-2-3 EC MIX resulted in the breakdown of gliadin proteins leading to a reduction of the reactive T-cell stimulation 4) 1-2-3 EC MIX performed better than store-bought tablets in the breakdown of gliadin 5) 1-2-3 EC MIX is safe for normal cells Based on these findings, I am confident that this will be a solution for CD and gluten intolerance. This research will provide a path to move ahead to formulate the “Glu-relief pill” based on 1-2-3 EC MIX.

Awards Won:
First Award of $5,000
Arizona State University: Arizona State University ISEF Scholarship (valued at up to $52,000 each)