Inhibition of Protein Enzyme Alliinase Utilizing Ligand Docking and Genetic Algorithms

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The tear-inducing chemical, or lachrymatory factor, syn-propanethial s-oxide, is released from onions when their cells are disrupted. The reaction creating this chemical is catalyzed by the enzyme, alliinase. It was hypothesized that if naturally occurring small organic molecules (ligands) could be identified that can bind strongly to the active site of the alliinase, then binding of these ligands on the active site of alliinase would reduce the enzymatic activity, hence eliminating or reducing the tear causing effects while chopping onions. The three dimensional crystal structure of alliinase was taken from the protein data bank. A large number of naturally occurring ligands were downloaded from the ZINC database. The binding energy of the ligands for the active site of alliinase was then calculated using a protein-docking tool, PyRx. The resulting binding energies were obtained, where a score of -7.5 kcal/mol or less was considered as strong binding. To ensure that the selected molecules are not toxic, the drug-likeness score of each molecule was calculated using a Python code (QED score, greater than 0.7). The best molecules were identified. These molecules were fragmented into smaller fragments by breaking single bonds between the atoms. The molecular fragments of different molecules were combined to form new molecules. These molecules were again tested for their binding affinity for alliinase. In total, 3352 molecules met the standards, with the top 10 chosen based on calculated metrics. These chemicals should be studied further to determine their effectiveness in combating the lachrymatory effects of onions.

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