

A Basic Modeling Approach for the 3D Protein Structure of Insulin

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Abstract : Proteins play a fundamental role in biology, but their structure is complex, and it is a challenge for teachers to conceptually explain the differences between their primary, secondary, tertiary, and quaternary structures. On the other hand, there are currently many computer programs to visualize the 3D structure of proteins, but they require advanced training and knowledge. Moreover, it becomes difficult to visualize the sequence of amino acids in these models, and how the protein conformation is reached. Given this drawback, a simple and instructive procedure is proposed in order to teach the protein structure to undergraduate and graduate students. For this purpose, insulin has been chosen because it is a protein that consists of 51 amino acids, a relatively small number. The methodology has consisted of the use of plastic atom models, which are frequently used in organic chemistry and biochemistry to explain the chirality of biomolecules. For didactic purposes, when the aim is to teach the biochemical foundations of proteins, a manipulative system seems convenient, starting from the chemical structure of amino acids. It has the advantage that the bonds between amino acids can be conveniently rotated, following the pattern marked by the 3D models. First, the 51 amino acids were modeled, and then they were linked according to the sequence of this protein. Next, the three disulfide bonds that characterize the stability of insulin have been established, and then the alpha-helix structure has been formed. In order to reach the tertiary 3D conformation of this protein, different interactive models available on the Internet have been visualized. In conclusion, the proposed methodology seems very suitable for biology and biochemistry students because they can learn the fundamentals of protein modeling by means of a manipulative procedure as a basis for understanding the functionality of proteins. This methodology would be conveniently useful for a biology or biochemistry laboratory practice, either at the pre-graduate or university level.

Keywords : protein structure, 3D model, insulin, biomolecule

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