

A Novel Scoring Function for Predicting the Conformation of Pairs of Tightly Packed α -Helices in Transmembrane Proteins

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Many pairs of helices in transmembrane (TM) proteins are tightly packed. We present a scoring function and a computational methodology for predicting the tertiary fold of a pair of α -helices, such that its chances of being tightly packed are maximized. Since the number of TM protein structures solved to date is small, it seems unlikely that a reliable scoring function derived statistically from the known set of TM protein structures will be available in the near future. We therefore constructed a scoring function based on the qualitative insights gained in the past two decades from the solved structures of TM and soluble proteins. In brief, we reward the formation of contacts between amino acids such as Gly, Cys, and Ser, that are known to promote dimerization of helices, and penalize the burial of large amino acids such as Arg and Trp. As a case study, we show that our method predicts the native structure of the TM homodimer glycophorin A (GpA) to be, in essence, at the global score optimum. In addition, by correlating our results with empirical point mutations on this homodimer, we demonstrate that our method can be a helpful adjunct to mutation analysis. We present a data set of canonical a -helices from the solved structures of TM proteins, and provide a set of programs for analyzing it (http:/ /ashtoret.tau.ac.il/~sarel). From this data set we derived 11 helix pairs, and conducted searches around their native states as a further test of our method. Approximately 73% of our predictions showed a reasonable fit (RMS deviation < 2 Å) with the native structures compared to the success rate of 8%, which is expected by chance.

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