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Molecular docking of rat myostatin with human follistatin: an in-silico analysis

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Abstract

Myostatin (MSTN) belongs to transforming growth factor-beta (TGF- $\boldsymbol{\beta}$) family as an autocrine/paracrine hormone produced mainly by muscle cells that inhibits muscle mass development. Follistatin is known to antagonize the function of TGF-$\boldsymbol{\beta}$ ligands, such as MSTN and activin A. Therefore, the aim of this study was to predict the 3D structure of rat (Rattus norvegicus) MSTN and investigate the interaction between rat MSTN and human (Homo sapiens) follistatin with molecular docking method. This method could provide insights into increase muscle mass in animals. The rat MSTN structure was predicted with Swiss-model server, and evaluated with SAVES 6.0 online server. Then, the interactions of rat MSTN with human follistatin (retrieved from UniProt: P19883) were performed using H-DOCK online server based on a hybrid algorithm of template-based modeling and ab-initio free docking. The Verify3D assessment of rat MSTN three-dimensional indicates that this protein having appropriate compatibility with 1D and 3D protein structures. ERRAT is an online server that could show incorrect regions of protein structures according to errors leading to random distributions of atoms, which can be distinguished from correct distributions. The ERRAT score for the predicted rat MSTN was 80% which was in the acceptable range. The Ramachandran plot is the 2d plot of the $\boldsymbol{\Phi}$-$\boldsymbol{\Psi}$ torsion angles of the protein backbone that provided overall view of protein conformation. Ramachandran plot indicated that in the predicted rat MSTN, around 80% residues belonged to the most favored regions. The docking result showed that human follistatin can be connected tightly to the predicted rat MSTN with a docking score of -244.73. Furthermore, the amino acids involved in the hydrogen bond including, H324, H326 and Y322 with hydrogen bond distances of 2.7, 3.5 and 1.9, respectability. The results of this study indicated possible application of human follistatin to inhibit rat MSTN, although further molecular dynamics study in addition to in-vitro experiments are required.

Keywords: Follistatin, Rattus norvegicus, Myostatin, Muscle, Molecular Docking