Molecular Docking Analysis of Sitosterol from Miconia crenata Against NEK2 (PDB ID: 2W5A) for Potential Prostate Cancer Therapy

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Abstract

Prostate cancer remains a major global health challenge, necessitating the search for safer and more effective therapeutic candidates. NEK2, a key cell-cycle regulatory kinase, is increasingly recognized as a potential drug target due to its role in chromosomal instability and tumor progression. This study investigates the dynamic interaction between sitosterol, a bioactive phytocompound from *Miconia crenata*, and NEK2 (PDB ID: 2W5A) using all-atom molecular dynamics simulation. Over a 100 ns trajectory, the sitosterol–NEK2 complex exhibited stable conformational behavior, supported by low RMSD fluctuations (0.23 ± 0.03 nm), minimal residue flexibility, and consistent protein compactness and solvent exposure patterns. PCA and free-energy landscape analyses confirmed limited conformational drift and a stable global energy minimum. MM-PBSA calculations revealed a favorable binding free energy (−110.76 ± 17.37 kJ/mol), outperforming the standard inhibitor. These findings suggest sitosterol as a promising natural NEK2 inhibitor with potential relevance in prostate cancer therapeutics.

Keywords: NEK2 kinase, Molecular dynamics simulation, Sitosterol, Prostate cancer therapy, *Miconia crenata.*