Interaction of Curcumin with One Subunit of Monoamine Oxidase-B in Comparison with Safinamide: An In Silico Study

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Received 2019 February 06; Revised 2019 February 26; Accepted 2019 March 02.

Abstract

Curcumin is a plant derivative with biological effects, including potential for the treatment of Parkinson’s disease (PD). It is known that monoamine oxidase B (MAO-B) is involved in PD due to its role in the degradation of various neurotransmitters like dopamine, the main declined factor in PD. Since MAO-B inhibitors (e.g. safinamide) are used as the support for the treatment of PD, we planned to evaluate the in silico interaction of curcumin with one subunit of the MAO-B enzyme in comparison with safinamide. The crystal structure of human MAO-B (PDB entry code 3PO7) was selected from the Protein Data Bank (https://www.rcsb.org). The molecular structures of curcumin (CID: 969516) and safinamide (CID: 131682) were obtained from PubChem (https://pubchem.ncbi.nlm.nih.gov). Chimera 1.8, AutoDock Tools-1.5.6 software and AutoDock4 software were used for this in silico study. The results revealed that the binding energies (∆G) of the conformations of curcumin and safinamide, showing the best down ∆G, were -11.15 kcal/mol and -11.09 kcal/mol, respectively. Moreover, the inhibition constants (Ki)s of both ligands were near quantities. Hence, it may suggest that curcumin and safinamide form nearly similar stability with the subunit of the MAO-B enzyme. More experimental studies may reveal the similarity of curcumin with safinamide about the inhibitory effect on MAO-B.

Keywords: Curcumin, Safinamide, Monoamine Oxidase B, Docking

1. Background

Curcumin is a natural polyphenol compound with several biological and medicinal effects (Figure 1A) (1). Curcumin is derived from the curry spice turmeric that is produced in several Asian and South-American countries (1, 2). Accordingly, curcumin shows potential for the treatment of neurological diseases including Parkinson’s disease (PD) (1).

Monoamine oxidases A and B (MAO-A and MAO-B) are the two human isoenzymes of the monoamine oxidase enzyme (3). The MAOs are flavin-dependent mitochondrial enzymes that are involved in the oxidative degradation of various aromatic amine-containing neurotransmitters (3). Evidently, MAO-B is involved in neurodegenerative diseases including PD, which is related to dopaminergic neuron degeneration (4). Since MAO-B inhibitors can selectively inhibit the metabolism and increase the synthesis of dopamine (4), they are presently used as the support for the treatment of PD (3). For instance, safinamide is a highly selective and reversible MAO-B inhibitor that is part of the management of PD (Figure 1B) (5).

2. Objectives

Accordingly, we intended to evaluate the in silico interaction of curcumin with one subunit of the MAO-B enzyme in comparison with safinamide, the well-known MAO-B inhibitor.

3. Methods

The crystal structure of human MAO-B (PDB entry code 3PO7, 1.8Å³ resolution) in complex with zonisamide was selected from the Protein Data Bank (https://www.rcsb.org) (6). Chimera 1.8 software was used for editing the enzyme protein and building the extension file “pdb”. As the MAO-B forms a homo-dimer (7), we selected one subunit (chain B) for this docking procedure; moreover, all other molecules were deleted except FAD cofactor (8).

The structures of ligand molecules, including curcumin (CID: 969516) and safinamide...
Figure 1. Chemical structures of curcumin (A) and safinamide (B). MarvinSketch was used for illustrating the chemical structures, MarvinSketch 17.14.0, ChemAxon (https://www.chemaxon.com).
B by curcumin and tetrahydrocurcumin would be helpful in impeding the progression of PD (16).

In conclusion, the results of this in silico study revealed near quantities for $\Delta G$ and $K_i$ of the conformations of curcumin and safinamide, showing the best down $\Delta G$, in the interaction with one subunit of the MAO-B enzyme. Certainly, more experimental studies are required to disclose the similarity of curcumin with safinamide about the inhibitory effect on MAO-B for the treatment of PD.

Acknowledgments

We are grateful to Autodock, ChemAxon, and Chimera for giving us permission to use the valuable software. We thank Neuroscience Research Center and Iran University of Medical Sciences for supporting this study.

Footnotes

Conflict of Interests: The authors declare that there are no conflict of interest.

Funding/Support: Neuroscience Research Center and Iran University of Medical Sciences.

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