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ADMET and molecular docking studies of organic-inorganic hybrid
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anti-inflammatory and antioxidant activities.

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الملخص

يرتكز هذا العمل على دراسات حاسوبية (*in silico*) باستخدام تقنيات رقمية لدراسة الإمكانات المضادة للالتهابات والمضادة للأكسدة لمواد هجينة عضوية-غير عضوية ومركبات الفوسفونات. تم استخدام برنامجي ChemDraw و ChemSketch لرسم هياكل أربعة وعشرون ممتزجة، ثم أجريت عليها محاكاة الالتحام الجزيئي مع بروتينين مستهدفين: 1HD2 مرتبط بالإجهاد التأكسدي و 2AZ5 مرتبط بالالتهاب تمت المحاكاة باستخدام برنامج MOE software. أظهرت النتائج أن هذه المركبات تمتلك خصائص مضادة للالتهاب ومضادة للأكسدة. قيمة R الناتجة عن تحليل تراكب المجمعات الممتزجة مع البروتين كانت بين 1.5 و 2 Å، مما يدل على تطابق جيد داخل المواقع الفعالة للبروتينات.

الكلمات المفتاحية:

MOE software، مضاد للالتهاب، مضاد للأكسدة، المحاكاة الحاسوبية (*In silico*)، الخصائص الدوائية ADMET، قواعد ليبينسكي.

Abstract

This study is based on *in silico* analysis using computational tools to explore the anti-inflammatory and antioxidant potential of organic-inorganic hybrid materials and phosphonate compounds. ChemDraw and ChemSketch software were used to draw the structures of twenty-four chelating agents. These were then subjected to molecular docking with two proteins: 1HD2 (related to oxidative stress) and 2AZ5 (involved in inflammation). Docking simulations were performed using MOE (Molecular Operating Environment). The results showed that the compounds exhibited promising anti-inflammatory and antioxidant properties. The RMSD values of the chelator-protein complexes ranged between 1.5 and 2 Å, indicating good binding and alignment within the protein active sites.

Keywords: MOE software, anti-inflammatory, antioxidant, *in silico*, ADMET, Lipinski's rules.

Résumé

Ce travail repose sur des études *in silico*, utilisant des méthodes informatiques pour explorer le potentiel anti-inflammatoire et antioxydant de matériaux hybrides organiques-inorganiques et de composés phosphonates. Les logiciels ChemDraw et ChemSketch ont été utilisés pour dessiner la structure de vingt-quatre chélateurs. Ces structures ont ensuite été soumises à une simulation de docking moléculaire avec deux protéines cibles : 1HD2 (liée au stress oxydatif) et 2AZ5 (impliquée dans l'inflammation). Les simulations ont été effectuées avec le logiciel MOE. Les résultats ont montré que ces composés possèdent des propriétés anti-inflammatoires et antioxydantes prometteuses. Les valeurs RMSD obtenues varient entre 1,5 et 2 Å, ce qui indique un bon ajustement des chélateurs dans les sites actifs des protéines.

Mots-clés : MOE software, anti-inflammatoire, antioxydant, *in silico*, propriétés ADMET, règles de Lipinski.

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List of abbreviations

2D: 2 dimension.

3D: 3 dimension.

Å: Angstrom.

ADMET: Absorption, Distribution, Metabolism, Excretion, and Toxicity.

Aln: Alanine.

Arg: Arginine.

Asn: Asparagine.

Asp: Aspartic acid.

BBB: blood-brain barrier (BBB) permeability.

CASF: comparative assessment of scoring function.

CLR: C-type lectin receptor.

COX: cyclooxygenase.

CYP450s: Cytochrome P450 proteins.

Cys: Cysteine.

DAMP: danger associated molecular pattern.

DNA: deoxyribonuclei acid.

EPSPsynthase: 5-enolpyruvylshikimate-3-phosphate synthase.

Gln: Glutamine.

Glu: Glutamic acid.

Gly: Glycine.

HBA: hydrogen bond acceptors.

HBD: hydrogen bond donors.

HIF1- α : hypoxia-inducible factor-1 α .

His: Histidine.

HIV: human immunodeficiency virus.

IG: gastrointestinal absorption.

IL-1 β : interleukin-1 β .

IL-6: interleukin-6.

Ile: Isoleucine.

iNOS: nitric oxide synthase.

IR: infrared.

kDa : kilo Dalton.

Leu: Leucine.

LogP: partition coefficient (lipophilicity measure).

Lys: Lysine.

Met: Methionine.

microRNA: ribonucleic acid.

MOE: Molecular Operating Environment.

MSNs: Mesoporous silica nanoparticle.

NADPH: nicotinamide adenine dinucleotide phosphate.

NCBI: National Center for Biotechnology Information.