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THEME

Synthesis, Characterization and Biological Activities of New Thiocarbohydrazide Schiff bases Derivatives

Presented by
Kaouther ZEMMIT
Tahani MERROUCHE

Supervised by
Dr. Abdelghani MADANI

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Jury Members

President	Dr. KACEM Nassira	University Setif 1- Ferhat ABBAS
Supervisor	Dr. MADANI Abdelghani	University Setif 1- Ferhat ABBAS
Examiner	Dr. ZIANI Nouara	University Setif 1- Ferhat ABBAS

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General Introduction

General introduction

Organic chemistry is central to the design of new molecules with varied properties, in response to the growing needs of the pharmaceutical, biological, and industrial sectors to prevent corrosion of mild steel [1-5]. The development of new compounds, particularly Schiff base ligands, has become a very attractive field of research, with several researchers devoting themselves to developing these ligands from organic and biological molecules.

Schiff bases are significant due to their structural simplicity, chemical stability, and the presence of the azomethine group (–C=N–), which imparts intriguing reactive properties and a broad spectrum of applications. Additionally, the abundance of donor atoms, such as particularly nitrogen, oxygen and sulfur, is crucial because of their free electron pairs [6].

The applications of thiocarbohydrazide in synthetic organic chemistry and biological sciences have recently been eviewed [7].

Thiocarbohydrazide represent a class of small molecules with various pharmacological properties [8], including antiviral [9], antibacterial [10], and antitumor activities [11–13]. The biological properties of thiocarbohydrazide have been extensively studied in pharmaceutical chemistry, particularly in inorganic medicinal chemistry, due to their ability to act as chelating agents for metal ions and the crucial role that metal coordination plays in their biochemical activity.

While thiosemicarbazones exhibit wide pharmacological versatility as a general class of compounds, their activity can be further refined and directed toward specific therapeutic applications [14]. Industrially, their strong chelating ability enables the formation of metal complexes such as Ni(II)-, Cu(II)-, and Fe(III)-thiocarbohydrazones, which are used in catalysis, corrosion inhibition, and analytical chemistry. This is due to the unique balance of electronic properties, structural adaptability, and bioavailability, making them attractive candidates for drug development. Of utmost importance is their metal-chelating ability, which plays a key role in their biological and catalytic activities [15–16], The work presented in this thesis is divided into three chapters:

The first chapter contains a bibliographic review of the work carried out on the synthesis of thiocarbohydrazide -type Schiff bases and their applications in various fields, such as biology, as antimicrobial, antioxidant, and antifungal agents.

The second chapter covers the synthesis and the physicochemical characterization methods, including FT-IR, UV-Vis, and NMR spectroscopy.

The third chapter presents the synthesis, the biological tests, and the discussion of the obtained results

Finally, this work is concluded with a general conclusion that summarizes the established results and outlines future perspectives in light of these findings

Abstract

This work focuses on the synthesis, characterization, and biological evaluation of three novel asymmetric thiocarbohydrazide-based Schiff base derivatives (TCHB, TCHD, and TCHF). Synthesized via the condensation of TCH with benzoin, dehydroacetic acid, or furoin, these compounds were isolated with satisfactory yields ranging from 32.5% to 39.5%. Their structures were confirmed by physicochemical and spectroscopic analyses (FT-IR, UV-Visible), validating the presence of azomethine, thiocarbonyl, hydroxyl, and carbonyl functional groups. In vitro biological evaluation revealed a selective activity profile: compound TCHF demonstrated potent antioxidant activity (ABTS radical scavenging, IC_{50} = 7.18 µM), whereas no significant anticholinesterase activity (BChE inhibition) was observed for any of the tested molecules

Résume

Ce travail porte sur la synthèse, la caractérisation et l'évaluation biologique de trois nouveaux dérivés asymétriques de bases de Schiff à base de thiocarbohydrazide (TCHB, TCHD et TCHF). Synthétisés par condensation de la TCH avec la benzoïne, l'acide déhydroacétique ou la furoïne, ces composés ont été isolés avec des rendements satisfaisants (32,5 % - 39,5 %). Leurs structures ont été confirmées par des analyses physico-chimiques et spectroscopiques (FT-IR, UV-Visible), validant la présence des groupements azométhine, thiocarbonyl, hydroxyle et carbonyle. L'évaluation biologique in vitro a révélé un profil sélectif : le composé TCHF a démontré une puissante activité antioxydante (piégeage des radicaux ABTS, IC_{50} = 7,18 µM), tandis qu'aucune activité anticholinestérasique significative (inhibition de la BChE) n'a été observée pour l'ensemble des molécules testées**.**

ملخص

يركز هذا العمل على تخليق وتوصيف وتقييم النشاط البيولوجي لثلاثة مشتقات جديدة غير متماثلة لقواعد شيف TCHB، TCHD، TCHF المعتمدة على ثيوكاربوهيدرازيد

تم تحضير هذه المركبات عبر تفاعل التكاثف بين ثيوكاربوهيدرازيد (TCH) وكل من البنزوين، حمض الديهدروأسيتيك، و الفوروئين، حيث تم عزلها بنسب مردود مرضية تتراوح بين **32.5%** و **39.5%**. تم التأكيد من التراكيب الجزيئية لهذه المركبات باستخدام تقنيات التحليل الفيزيائي-الكيميائي والطيفي مطيافية الأشعة تحت الحمراء بتحويل فوريهFT-IR ، ومطيافية الأشعة فوق البنفسجية-المرئية(UV-Visible) ، مما أثبت وجود المجموعات الوظيفية: أزوميثين، وثيوكاربونيل، وهيدروكسيل، وكاربونيل. وقد كشف التقييم البيولوجي في المختبر (In vitro) عن ملف نشاط انتقائي؛ حيث أظهر المركب TCHF نشاطًا قويًا مضادًا للأكسدة كسح جذور ABTS الحرة، IC_{50} = 7. ميكرومولار، في حين لم يُلاحظ أي نشاط ملحوظ كمثبط للكولينستيراز تثبيط إنزيم البيوتيريل كولينستيراز (BChE) لأي من الجزيئات التي تم اختبارها.