Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University / College of Science

Department of Chemistry

Molecular spectroscopy

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

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Supervised by : Dr. Zaman Sahib Mahdi

2025 AD **1446 AH**

Abstract

This research addresses the topic of "molecular spectroscopy," one of the most important modern methods used to study the properties of materials and determine their chemical structures. This type of analysis relies on the principle of molecules absorbing electromagnetic radiation at specific wavelengths, enabling a precise understanding of the structure and interactions of chemical compounds. The research begins with a detailed presentation of the theoretical foundations of electromagnetic radiation, in terms of its wave and particle nature, the types of electronic transitions that occur within molecules, such as $\sigma \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$, and $n \rightarrow \pi^*$, and their effect on molecular absorbance. The Beer links absorption intensity to the concentration of a substance, is also explained. The research addresses the components of spectroscopic instruments used in analysis, such as light sources (such as deuterium and tungsten lamps), methods for selecting wavelengths (such as colorimeters and filters), and types of instruments (single-beam, dual-beam, and multi-channel). The applications of this analysis in the medical, environmental, and industrial fields were also presented, in addition to studying the factors affecting the analysis results, such as the type of solvent, the degree of coupling, and the intensity of radiation.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Heterogeneous transition metal catalyst for fine chemical synthesis hydrogen- Auto transfer reaction

A research submitted to the Council of College of Science

Al-Muthanna University as partial Fulfillment of the Requirement for the Degree of B.Sc. of Science in Chemistry

By

Maha Rahim Saheb Hussein Ali Ayash

Supervised By Assist Lec . Duha Majeed

2025A.D **1446A.H**

Abstract

Fine chemicals are produced in small annual volume batch processes (often <10,000 tonnes per year), with a high associated price (usually >USD 10/kg). As a result of their usage in the production of speciality chemicals, in areas including agrochemicals, fragrances, and pharmaceuticals, the need for them will remain high for the foreseeable future. This review article assesses current methods used to produce fine chemicals with heterogeneous catalysts, including both well-established and newer experimental methods. A wide range of methods, utilising microporous and mesoporous catalysts, has been explored, including their preparation and modification before use in industry. Their potential drawbacks and benefits have been analysed, with their feasibility compared to newer, recently emerging catalysts. The field of heterogeneous catalysis for fine chemical production is a dynamic and ever-changing area of research. This deeper insight into catalytic behaviour and material properties will produce more efficient, selective, and sustainable processes in the fine chemical industry. The findings from this article will provide an excellent foundation for further exploration and a critical review in the field of fine chemical production using micro- and mesoporous heterogeneous catalysts.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Role of hydrogel:as adsorption surface for removal organic dye from aqueous solution

A research submitted to the Council of College of Science

Al-Muthanna University as partial Fulfillment of the Requirement for the Degree of B.Sc. of Science in Chemistry

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2025A.D **1446A.H**

Abstract

Water pollution by organic dyes continues to pose a serious health and environmental threat to the ecosystem. Although adsorption using biopolymerbased hydrogels has proven to be an ideal technique for the treatment of these dye contaminants from solutions, these hydrogels suffer from lack Of mechanical stability and ræovery as compared to synthetic polymers. Here in, we focus on the low-cost synthesisof hydrogel incorporated with inorganic components mainly focusing on strategies to improve the mechanical stability and separation of the hydrogel in removing some dyes from aqueous solution. The literature shows that hydrogel nanocomposites are a class of materials that have flourished significant consideration, especially concerning water treatment. In adsorption technology, hydrogel nanocomposites act as absorbents, prominent to enhance their removal efficiency towards contaminants.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Study biological Activity of Heterocyclic Compounds

A research submitted to the Council of College of Science

Al-Muthanna University as partial Fulfillment of the Requirement for the Degree of B.Sc. of Science in Chemistry

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2025A.D **1446A.H**

Abstract

This research aims to study and analyze the biological activity of a group of laboratory-synthesized heterocyclic compounds, by evaluating their ability to affect a range of different biological targets. This research focused on five main types of biological activity: antifungal, anti-inflammatory, anticancer, antioxidant, and activity associated with the prevention of Alzheimer's disease.

The results of the biological evaluation showed that a number of the prepared compounds demonstrated high efficacy in inhibiting fungal growth, reducing inflammation, and inhibiting the growth of cancer cells, in addition to their ability to inhibit free radicals and enzymes associated with Alzheimer's disease.

Some of the compounds demonstrated efficacy comparable to or higher than reference drugs such as fluconazole (antifungal), nimesulide (anti-inflammatory), doxorubicin (anticancer), vitamin C (antioxidant), and donepezil (for the treatment of Alzheimer's disease). The study recommends conducting additional studies to expand the clinical application of these compounds and verify their pharmacological and toxicological properties.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University

College of Science

Department of Chemistry

Solar Cells

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

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2025A.D **1446A.H**

Abstract

Solar cells, or photovoltaics, are devices and devices in the form of cells arranged side by side that convert sunlight into electricity by exploiting the photovoltaic effect. Solar cells have been used for decades, on satellites since 1996. They also supply electricity to the International Space Station (ISS). Currently, the largest solar-powered power plant is located in Spain, with a capacity of approximately 23 megawatts. Plans are also underway to build the largest solarpowered power plant in Spain, with a capacity of approximately 154 megawatts.

This research discusses the applications of solar cells, which, in addition to their primary role in generating electricity, are also applied to residential buildings. Several factors and considerations are identified when designing photovoltaic cells in buildings and selecting their systems.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University

College of Science

Department of Chemistry

Antioxidant properties and hypoglycemic potential of grape (leaves, seeds, peels) extract

A project

submitted to the Chemistry Department / College of Science Al Muthanna University in partial fulfillment of the requirement for the Bachelor's degree in Chemistry Science

By

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Supervised by

Assist. Prof. Dr. Mona Hassoun Saoudi

2025A.D **1446A.H**

Abstract

This study investigated the biological activity of extracts derived from the leaves, seeds, and peels of locally cultivated grapes in Iraq, focusing on their antioxidant properties and their potential to lower blood glucose levels in patients with type 2 diabetes mellitus (T2DM). Aqueous and methanolic extraction methods were employed to obtain the plant extracts, and preliminary phytochemical screening revealed the presence of bioactive compounds such as phenolics, flavonoids, glycosides, and alkaloids. Grape seed extracts showed the highest levels of phenolic compounds, followed by peels and then leaves. Antioxidant assays, including the DPPH method, demonstrated notable free radical scavenging activity in all extracts. Furthermore, treatment with both aqueous and alcoholic extracts resulted in significant reductions in blood glucose levels among T2DM patients. Marked decreases were observed across all grape parts, with aqueous extracts showing reductions in glucose levels from elevated baseline values to near-normal ranges. These findings suggest that grape extracts may serve as promising natural sources of antioxidants and potential hypoglycemic agents, supporting their use in nutritional and pharmaceutical applications. However, further studies, including statistical analysis and mechanistic investigations, are required to validate these effects and to identify the specific bioactive compounds responsible.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University / College of Science

Department of Chemistry

Methods of preparing heterocyclic compounds

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students

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Munaa Waly Eatia

Supervised by

Lecturer: Asstabraq Mohsin Yasir

1446 AH **2025AD**

Abstract

Heterocyclic compounds, which are characterized by the presence of one or more heteroatoms within a ring structure, play vital roles in various fields such as chemistry, pharmacology and materials science. Their unique structural frameworks yield distinct chemical properties that facilitate a wide range of applications, including pharmaceuticals, agrochemicals, and advanced materials.

Among the prominent classes of heterocyclic compounds are the pentacyclic compounds, such as thiophene and imidazole. Thiophene (C_4H_4S), containing four carbon atoms and one sulfur atom, exhibits aromatic properties due to the delocalization of pi electrons. It is widely used in the manufacture of conducting polymers and organic semiconductors. Thiophene derivatives are also used in the production of agrochemicals, pharmaceuticals, and dyes, where they exhibit properties including antimicrobial, anti-inflammatory, and antifungal activities.

Imidazole ($C_3H_4N_2$), a five-membered ring containing three carbon atoms and two nitrogen atoms, is important in biochemistry and medicinal chemistry. It is a precursor to histidine, an essential amino acid. Imidazole-based compounds, such as antifungals (e.g., ketoconazole) and buffers (e.g., 1H-imidazole), are of great importance in various biological contexts. The electron-rich nature of imidazole enables multiple chemical applications, contributing to the development of catalysts and ligands in synthetic chemistry.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

HPLC Technology And Its Practical Applications

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

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Nour Al-Huda Hassan Attia

Supervised by

M: Nahla Ghazi Fahad

2025 AD **1446 AH**

Abstract

High-performance liquid chromatography (HPLC) is an advanced analytical technique essential for separating, identifying and quantifying the components of complex mixtures. Since its development in the late 1960s, HPLC has revolutionized analytical chemistry, impacting fields such as pharmaceuticals, environmental monitoring, food safety, and clinical diagnostics. HPLC works by pumping a mobile phase through a column filled with a stationary phase. Separation occurs based on the interaction between the analytes and the stationary phase, using techniques including normal-phase chromatography, reversed-phase chromatography, ion exchange, and size-exclusion chromatography. Normal-phase HPLC separates compounds based on their polarity using a polar stationary phase and a non-polar mobile phase, while reversed-phase HPLC is more commonly used due to its versatility. Technology has evolved significantly, with improvements in pump technology, specialized columns, and detection methods, particularly the integration of LC-MS and the development of ultra-high-performance liquid chromatography (UHPLC), which enhance speed and accuracy.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

The Practical Importance of Schiff's Rules in Medical and Pharmaceutical Aspects

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A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

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Athar Rashid Saib

Supervised by:

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2025 AD **1446 AH**

Abstract

Schiff bases, first described by Hugo Schiff in the late 19th century, are key intermediates in organic chemistry, formed through the condensation of primary amines with carbonyl compounds such as aldehydes or ketones. These compounds exhibit diverse chemical properties, making them valuable in various fields, especially in medicine and pharmaceuticals. Schiff bases are utilized in the synthesis of drugs with antimicrobial, anticancer, and anti-inflammatory properties, and they play a crucial role in diagnostic tools for disease detection. This research explores the theoretical foundations of Schiff bases, including their formation mechanisms, chemical properties, and characterization techniques. Additionally, the study delves into their practical applications, particularly in drug development and clinical diagnostics, emphasizing their significant contributions to enhancing treatment efficacy and patient outcomes. Hydrazides, a subclass of Schiff bases, are highlighted for their biological activity, including bactericidal and virucidal properties, with isoniazid being a prominent example used in tuberculosis treatment. The synthesis of Schiff bases is also discussed, focusing on reaction conditions, purification, and characterization methods. This comprehensive overview underscores the importance of Schiff bases and hydrazides in advancing scientific research and therapeutic interventions.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University / College of Science

Department of Chemistry

Treating Water Contaminated With Dyes Using The Adsorption Method

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

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Heba Ahmed Wali

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2025 AD **1446 AH**

Abstract

Water pollution is a critical environmental issue, exacerbated by industrialization and urbanization. Among various pollutants, synthetic dyes from industries such as textiles, paper, cosmetics, and food pose significant threats to aquatic ecosystems and human health due to their toxic, mutagenic, and carcinogenic properties. Traditional water treatment methods often prove inefficient in removing these persistent contaminants. Adsorption has emerged as a promising, cost-effective, and efficient technique for dye removal from wastewater. This study aims to evaluate the adsorption capabilities of different adsorbent materials, including activated carbon, natural clays, and agricultural waste products, in removing synthetic dyes. The research investigates the effects of operational parameters such as pH, temperature, and contact time on adsorption efficiency, as well as the adsorption kinetics and isotherm models governing the process. Additionally, the study assesses the reusability and economic viability of the selected adsorbents for real-world applications. The findings will contribute to the development of sustainable and effective wastewater treatment strategies, mitigating the environmental and health hazards posed by dye pollutants.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Preparation of Ionic Liquid Based on Imidazolium Salt

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

By Students:

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Taqi Khazal Talib

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2025 AD **1446 AH**

Abstract

This research addresses the preparation of ionic liquids based on imidazolium salts, which have received widespread attention in recent years due to their unique properties and diverse applications. Ionic liquids are salts that remain liquid at relatively low temperatures (below 100^0C) and are characterized by their composition of organic or inorganic cations and anions. These compounds exhibit important properties such as low vapor pressure, high thermal stability, broad electrochemical windows, and excellent solubility, making them effective alternatives to conventional solvents in chemical and industrial processes.

The research focused on the preparation of ionic liquids derived from imidazolium compounds through alkylation reactions with alkyl halides in polar, non-electrolytic solvents such as DMF or acetonitrile, while controlling the reaction conditions in terms of temperature and time to achieve the highest possible yield and purity. The study also addressed diversifying the properties of ionic liquids by modifying the alkyl chain length or changing the accompanying anion to improve their physical and chemical properties, suitable for different applications.

This work aims to enhance understanding of the properties of ionic liquids and expand their scope of use in line with green chemistry trends, by providing safer, more efficient, and environmentally friendly alternatives to traditional solvents, with a focus on sustainability and efficiency in chemical processes.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Synthesis of new compounds containing pyrozoline ring

This is submitted to the council of the collage of scientific - AlMothana University in a partial fulfillment requirement for the degree of bachelor in chemistry science.

By

Ali shareef abd

Supervizor

Prof Dr.Riyadh Jaleel Nahi

2025 AD **1446 AH**

Abstract

Pyrazoles have a wide range of applications in medicinal chemistry, drug discovery, agrochemistry, coordination chemistry, and organometallic chemistry.

Basically, Pyrazole (C3H3N2H) is a simple doubly unsaturated five membered heterocyclic aromatic ring molecule comprising two nitrogen (N) atoms at positions 1- and 2- and three carbon (C) atoms. Pyrazole nucleus is synthesized with various strategies such as multicomponent approach, dipolar cycloadditions, cyclocondensation of hydrazine with carbonyl system, using heterocyclic system and multicomponent approach.

A special emphasis is placed on a thorough examination of response processes.

The main purpose of the research is to prepare a heterocyclic compound containing pyrazole ring through cyclocondensation reactions.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Study of the Adsorption of Some Organic Pollutants in Aqueous Solutions on The Surface of Activated Carbon

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

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Abeer Karim Mahdi

Supervised by:

Prof. Dr. Khawla Kani Jassim

1446AH **2025 AD**

Abstract

This research examines the adsorption of some organic pollutants in aqueous solutions using activated carbon as one of the most effective materials for removing these pollutants. The study began with a comprehensive overview of the problem of environmental pollution, particularly water pollution, as it is one of the most dangerous types of pollution due to its direct impact on human health and the entire ecosystem. The focus was on organic pollutants, particularly synthetic dyes, due to their toxic and carcinogenic effects, as well as the difficulty of removing them using conventional methods. This has necessitated the search for effective and safe methods for treating them.

The second chapter of the research includes a detailed explanation of polyaromatic compounds as a form of organic pollutants that warrant special attention due to their chemical stability and difficulty in decomposing in the environment. The chapter also addresses the properties Of these compounds, their economic importance, and their industrial sources, highlighting the challenges facing their disposal. The study then moves on to examine activated carbon in terms of its types, preparation methods, and adsorption properties, which make it the ideal choice for treating polluted water. The multiple uses of activated carbon in industrial, medical, and environmental fields were also discussed, along with an explanation of the relationship between the chemical composition of activated carbon and its adsorption capacity, particularly the presence of inorganic elements or active groups that contribute to improving adsorption efficiency.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Study medical applications of some sulfur heterocyclic compounds

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

Maryam Abbas Kazim

Farah Majed Khalif

Supervised by

Assistant Teacher: Noor Hameed Imran

2025 AD **1446 AH**

الخلاصة

يقدم هذا البحث تعريفًا بالمركبات الحلقية غير المتجانسة، مشددًا على دورها الأساسي في الكيمياء الطبية واكتشاف الأدوية، وخاصةً تلك التي تحتوي على ذرات الكبريت. المركبات الحلقية غير المتجانسة هي مركبات عضوية ذات بنية حلقية تحتوي على ذرات غير كربونية (ذرات غير متجانسة) مثل النيتروجين والأكسجين والكبريت. تُستخدم هذه المركبات على نطاق واسع في الطبيعة والمستحضرات الصيدلانية. تتميز المركبات الحلقية غير المتجانسة المحتوية على الكبريت، مثل الثيازولات والثياديازولات والبنزوثيازولات، بخصائص مضادة للميكروبات، ومضادة للسرطان، ومضادة للالتهابات، ووقائية للأعصاب. ويشرح كيف تُعزز الخصائص الكيميائية للكبريت - مثل قدرته على تكوين روابط مستقرة والمشاركة في تفاعلات الأكسدة والاختزال - النشاط البيولوجي للمركبات الحلقية غير المتجانسة. ويُقدم تصنيف للمركبات الحلقية غير المتجانسة بناءً على حجم الحلقة، ونوع الذرة غير المتجانسة، ودرجة التشبع، والنشاط البيولوجي.

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

Adrenal Hormones

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by:

Ali rahi dnef

Kadhim Tahseen kadhim

Under supervision:

Dr. Shaima Hassan Malah

2025AD **1446AH**

Abstract

The adrenal glands are vital endocrine organs that regulate a wide range of physiological processes through the secretion of essential hormones. Structurally, each gland consists of two distinct parts: the adrenal cortex and the adrenal medulla. The adrenal cortex produces steroid hormones, including glucocorticoids (cortisol), mineralocorticoids (aldosterone), and androgens, while the adrenal medulla secretes catecholamines such as epinephrine and norepinephrine. This research provides an in-depth overview of the hormones produced by both regions and their functions in maintaining metabolic balance, cardiovascular stability, and the body's response to stress. Additionally, it explores various disorders related to adrenal hormone dysfunction, such as Congenital Adrenal Hyperplasia (CAH), hypersecretion and hyposecretion syndromes, and adrenal tumors. The paper also highlights the interplay between adrenal hormones and mental health, the influence of stress hormones on thyroid function, and the lifestyle factors that affect adrenal health. Diagnostic approaches and therapeutic strategies for adrenal gland disorders are examined, along with modern hormonal testing techniques and their clinical interpretations. By integrating physiological, pathological, and clinical perspectives, this study aims to provide a comprehensive understanding of adrenal gland function and its broader impact on human health

Republic of Iraq

Ministry of Higher Education and Scientific Research

Al-Muthanna University College of Science Department of Chemistry

The Importance of Heterocyclic Compounds (Thiazole Compounds) in the Industrial and Medical Fields

A research paper submitted to the Chemistry Department Council in the College of Science as part of the requirements for a Bachelor's degree in Chemistry.

Prepared by students:

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Ghofran Raad Hussein

Supervised by:

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2025 AD **1446 AH**

Abstract

Heterocyclic compounds play a fundamental role in organic chemistry, with widespread applications in pharmaceuticals, agriculture, and material sciences. These compounds are defined by their cyclic structures containing heteroatoms such as nitrogen, oxygen, or sulfur. Among them, thiazole derivatives exhibit significant chemical and biological importance, particularly in medicinal chemistry, where they contribute to the development of antimicrobial, anticancer, and anti-inflammatory drugs. Beyond medicine, heterocycles are crucial in agrochemicals, dyes, and polymers, underscoring their industrial significance. This study provides a comprehensive exploration of heterocyclic compounds, emphasizing their classification based on ring size, aromaticity, and origin—natural or synthetic. Through an in-depth examination of their structural diversity and applications, this research highlights the ongoing relevance of heterocycles in scientific advancements and industrial innovations.