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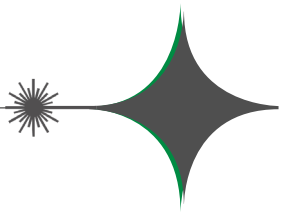

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Morphological Change in Human Liver Cancer Cells HepG2 Induced by Ampicillin-Chitosan

Zahraa Ayad Ali[1*] , Zainab Nizar Jawad[2]

[1]Department of Biology, College of Education for Pure Sciences, University of Kerbala, Karbala, Iraq
[2]Department of Optical Techniques, Al-Zahrawi University College, Karbala, Iraq.

P A P E R I N F O

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A B S T R A C T

In this work, the effectiveness of the binding of ampicillin, one of the beta-lactam antibiotics, with nano-chitosan extracted from the skeletons of marine crustaceans was tested on human liver cancer cells Hep G2 ex vivo. The results were positive, as the binding was effective through the weakening of the vibration peaks of the active functional groups, according to the results of FTIR test, and the drug was toxic to the aforementioned cell lines and its effect increases with the dose, causing them to lose the integrity of their membranes, shrinkage of their cytoplasm, and fragmentation of their DNA, which indicates the activation of the programmed death pathway in them. This confirmed the synergistic role of chitosan in enhancing the therapeutic effectiveness of Ampicillin.

1. INTRODUCTION

Cancer remains an enormous challenge and one of the top causes of mortality in the entire world.It arises from a defect in natural biological processes that manage cell division, causing cells to grow up normally, which produces masses of tissue known as cancerous tumors [1,2] . Hepatocellular carcinoma (HCC) ranks third among cancer-related causes of mortality globally. The majority of cases involve people who already have liver disease, specifically fibrosis or a fatty liver, plus infection with hepatitis B and C virus [3]. Cancer has been cured by a variety of antibiotics, the phrase "antibiotics" is Known as bacterial-producing secondary metabolism products that have anticancer properties. They block the unchecked growth and destroy cancerous cells in all stages of the reproductive cycle including those in the (G0) phase by activating programmed death through apoptotic genes like TP53 gene [4]. As a beta-lactam antibiotic, ampicillin has effects on the cell wall by preventing the formation of peptidoglycan, which is crucial for cell wall synthesis. It also weakens the cell wall and causes cell lysis by preventing transpeptidase enzymes from cross-linking peptidoglycan chains, which causes lysis and cell death [5]. Antibiotic overuse increases bacteria resistance to many drugs, creating severe danger. As a result, it is essential to minimize antibiotic dosages while increasing ANTIBIOTIC bioavailability. It can be complexed with polymer by direct linkage or encapsulation to improve biocompatibility, stability, degradability, and other properties. Antimicrobial monomers like chitosan serve to enhance the effectiveness of ampicillin through covalent bonds [6]. Chitosan is a synthetic polymer that lies under the polysaccharides group. It is created via deacetylating chitin contained in the exoskeletons of various crustaceans. its exceptional characteristics include non-toxicity and biocompatibility. Chitosan-metal bio nanocomposites have been used in drug delivery applications [7]. One extremely interesting treatment option for fighting tumor cells is by restoring TP53 to its function, which can be activated in response to various stresses such as damage to DNA, oxidative overload, deficiency in nutrients, hypoxia, telomere attrition, or cellular dysfunction via transcription regulation. Additionally, p53 can either promote or block the expression of numerous particular genes that are responsible for halting the cell cycle, repairing DNA, apoptotic, and suicide, That is how the keeper of the genome determines cell fate [8].

*Corresponding Author Institutional Email:
Zahraa.ayad@uokerbala.edu.iq (Zahraa Ayad Ali)

Objctive Of The Study

The aim of the research is to load the antibiotic ampicillin onto nano-chitosan in order to improve its therapeutic properties and then target HepG2 liver cancer cells ex vivo to measure the toxicity of the drug and the extent of its effect on the HepG2 liver cell line.

2. MATERIALS AND METHODS

2.1. Preparation NanoChitosan

a specific amount of the powdery chitin (Shaanxi Sang herb Bio-Techlnc) disintegrated in fifteen milliliters of water solution including four percent of CH3CO2H at forty-five degrees Celsius.The chitosan then gradually disintegrated until the liquid turned clear by using high-frequency sound waves for six hours and then left at room heat all-nighter to create chitosan nanocrystals and dry out using filter paper [9].

2.2 Preparation of Nano Chitosan-Ampicillin

After dissolving (9.2 g, 0.03 moles) ampicillin medication obtained from (SDI Company/Samarra) into thirty milliliters of tetrahydrofuran (Thomas Baker) and a total of 3 drops hydrochloric acid, the medication is added to the nano chitosan (5.0 g, 0.0005 moles) and placed under reflex over one full day. Lastly, a mixture of diethyl ether and 2.0 M sodium hydroxide was used to wash the debris, and it was allowed to dry for sixteen hours [10].

2. 3. Maintenance cell culture

The HepG2 cells of liver tumors was cultured in cell culture plates obtained from Santa Cruz Biotechnology in the USA. The cells were kept in 10 milliliters of Roswell Park Memorial Institute -1640 supplemented with 10% Fetal bovine serum, 100 units/mL penicillin, and 100 µg/mL streptomycin (Capricorn / Germany) The cells were cultured in a CO2 incubator (Cypress Diagnostics/Belgium) at 37 °C with 5% CO2 for 24 hours after being passaged using Trypsin-EDTA prepared from (Capricorn / Germany). The cells were then checked under a microscope to confirm their viability. Subsequently, albumin serum was added to halt the trypsin's action. After that, cancer cells (HepG2) were split using a centrifugal technique (200 revolutions per minute) and albumin serum was added after removing the filtrate,[11].

2. 4. Cytotoxicity Test

The purpose of the test was to gauge the malignancy cells' survival. To preserve the tetrazolium dye MTT (Invitrogen / USA) , until usage, 50 mg of its powder had to be dissolved in a hundred ml of phosphate buffer solution. HepG2 cells were grown in a plate with 96 wells and incubated to obtain a single layer of cells. The aforementioned cells were then treated with ampicillin, an antibiotic, loaded on nano chitosan at the following concentrations: (12.5 , 25 , 50 , 100 , 200 , 400 g/ml) . after 48 hours passed, the cells were washed and treated with MTT dye. After using dimethyl sulfoxide to remove the crystals, it was briefly incubated before being checked using a microplate reader, [12]. The tumor cell inhibition rate was calculated according to the equation below(1):

Percentage of inhibition = (optical density of the control sample -optical density of the studied sample)/(optical density of the control sample) X 100

2.5. Detection of Morphological Change

To examine the morphological change with an inverted microscope (Olympus / Japan), human liver cancer (HepG2) cells were placed into 24-well micro-titration plates and kept for 24 hours at 37 °C. Next, for a whole day, cells were exposed to nano chitosan-ampicillin. Following the treatment period, the plates were incubated for between ten and fifteen minutes at thirty-seven degrees Celsius after being colored with a violet crystal dye (Switzerland / Fluka), [13]. The stain was carefully cleaned using ordinary water till all traces of the pigment were gone. At a zoom level of 100×, HepG2 cells were studied with an inverted microscope, and by a digital camera, images were taken. Every analysis is done in triplicate.

3. RESULTS AND DISCUSSION

3.1 FTIR analysis

The FTIR technique had been used to determine the bonding of antibiotic ampicillin with polysaccharide. Functional groups including the secondary amine (N-H) (3135.78 cm-1), alcoholic (O-H) (3399.65cm-1), aromatic (3080.32cm-1), and aliphatic (C-H) (2976.16cm-1), ester group (1726.29cm-1), amide group (1681.93cm-1), and (C-O) band (1263.37cm-1), are responsible for the vibrations seen in figure (1). This indicated the efficiency of cross-linked bonds, Among the considerations that contributed to the selection of chitosan for loading with drugs were the existence of a functional amino group, a large surface area linked to the c=c group, and hydroxyl and carboxyl groups at the surface or border of the chitosan. These properties offer opportunities for medicine loading via hydrogen-bonded and electric interactions,[14].

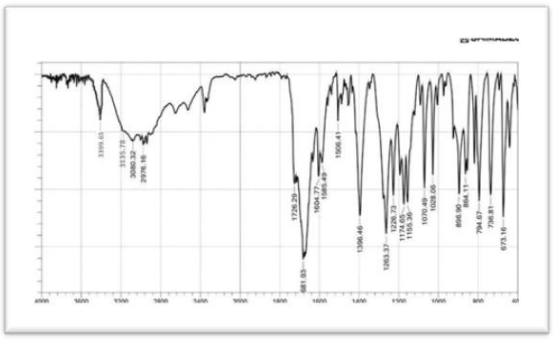

Figure 1. FTIR for Chitosan- ampicillin

3.2. Cytotoxicity Test

The results of the test are shown in (Figure2) , where a decrease in the number of cells can be observed coinciding with an increase in the dose and based on the basic principle of the work of the MTT dye.The mitochondria of healthy cells have the ability to convert this yellow-colored dye into purple, water-insoluble crystals, the percentage of which is determined. Color intensity of healthy cells is measured and this is what cells, that have lost the integrity of their membranes, cannot do.This confirms the damage to the membranes of cancerous liver cells which is due to the effect of the ampicillin-chitosan drug [15,16] .

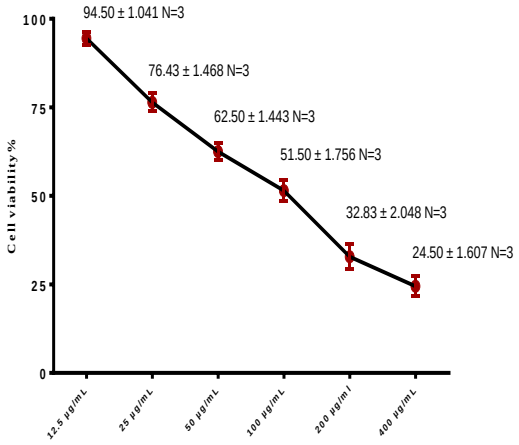

Figure 2. Cytotoxicity of Chitosan-Ampicillin in HepG2 cells. IC50=69.09 µg/ml

3.3. Morphological Change in HepG2 cells

The HepG2 cells were subjected to the half-lethal dose for over a day before being painted with crystal violet dye and examined with a 100 x magnification microscope. Morphological variations in the liver malignant cells treated with ampicillin are loaded on chitosan as Figure (4) shows.This is in contrast to the changes seen in Figure (3) of non-drug exposed cancer cells.

Regarding the untreated cells' membrane integrity, there is a noticeable difference. The cell's cytoplasm has been stained violet in color and its nucleus looks tiny and transparent. They resemble small cell aggregates with dull-colored cytoplasm, as opposed to the cancer cells that were treated with the medication. Furthermore, there seems to be a lack of unique borders on the outermost layer of the cell's membrane , Which shows the effect of nano drug on them. The principles behind the usage of antibiotic as antitumor therapy are based on their capacity to suppress cell division in addition to its pro-apoptotic and anti-epithelial-to-mesenchymal transition actions. A variety of antibiotics have found application in the treatment of cancer. Research studies have validated our findings, showing that ampicillin inhibits the growth of blood vessels in cancer cells, hence having an anti-cancer impact [17].

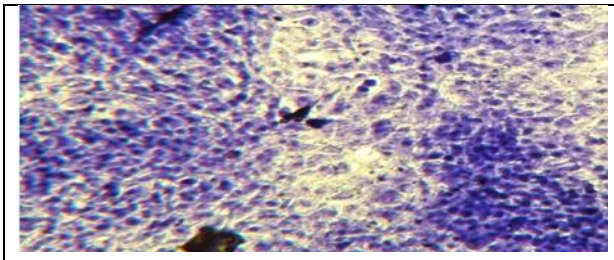

Figure 3 . Non-drug exposed cancer cells HepG2 cells

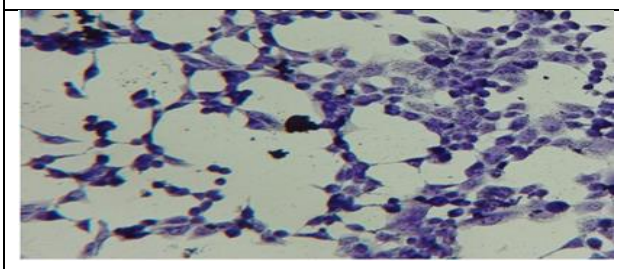

Figure 4. HepG2 cells that exposed to Chitosan-Ampicillin

4. CONCLUSION

After treating HepG2 liver cancer cells with the antibiotic ampicillin loaded on nanochitosan and measuring its toxic effects and the changes it caused on the aforementioned cell line, we concluded that the drug led to the killing of cancer cells and caused the activation of p53, which stimulated the programmed death pathway in them.This in turn opens promising doors for the treatment of liver cancer.

5 . REFERENCES

1- "Molecular detection of GSTM1 and GSTT1 gene polymorphisms and their 2022, Abdulla, A.J., & Jawad, Z.N. (2022). Molecular detection of GSTM1 and GSTT1 gene polymorphisms and their association with prostate cancer risk. *International journal of health sciences*.https://www.semanticscholar.org/paper/Molecular-detection-of-GSTM1-and-GSTT1-gene-and-Abdulla-Jawad/97d9552b8968d442eee8eb0384a01891eeebb71c.

2- Jawad, Z. N. (2023). Association Between APC Gene SNPs and the Risk of Occurrence of Colorectal Cancer. In AIP Conference Proceedings (Vol. 2414). American Institute of Physics Inc. https://doi.org/10.1063/5.0114675

3- Serraino, D., Fratino, L., & Piselli, P. (2023). Epidemiological Aspects of Hepatocellular Carcinoma (pp. 3–9). https://doi.org/10.1007/978-3-031-09371-5_1

4- Gao, Y., Shang, Q., Li, W., Guo, W., Stojadinovic, A., Mannion, C., Man, Y.g., Chen, T. (2020). Antibiotics for cancer treatment: A double-edged sword. Journal of Cancer, 11(17), 5135-5149. https://doi.org/10.7150/jca.47470.

5- Peechakara BV, Basit H, Gupta M. Ampicillin. [Updated 2023 Aug 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK519569/

6- Thottathil, S., Puttaiahgowda, Y. M., & Kanth, S. (2023). Advancement and future perspectives on ampicillin-loaded antimicrobial polymers- A review. *Journal of Drug Delivery Science and Technology*, *81*, 104227.https://doi.org/10.1016/j.jddst.2023.104227

7- Ali, M., Mir, S., Abid, O., Ajlouni, A., Ghafoor Alvi, S., & Bibi, S. (2023). Applications Of Chitosan Based Bionanocomposites In Drug-Delivery And Anticancer Treatment-A Review. *European Polymer*Journal, 201, 112576. https://doi.org/10.1016/ j.eurpolymj .2023.112576

8- Aguilar, A., & Wang, S. (2022). Therapeutic Strategies to Activate p53. *Pharmaceuticals*, *16*(1), 24. https://doi.org/10.3390/ph16010024

9- Herdiana, Y., Wathoni, N., Shamsuddin, S., Joni, I. M., & Muchtaridi, M. (2021). Chitosan-Based Nanoparticles of Targeted Drug Delivery System in Breast Cancer Treatment. *Polymers*, *13*(11). https://doi.org/10.3390/polym13111717

10- Jha, R., & Mayanovic, R. A. (2023). A Review of the Preparation, Characterization, and Applications of Chitosan Nanoparticles in Nanomedicine. *Nanomaterials*, *13*(8). https://doi.org/10.3390/nano13081302

11- Jasim, A., Sulaiman, G., Ay, H., Mohammed, S., Mohammed, H., Jabir, M. & Khan, R. (2022). Preliminary trials of the gold nanoparticles conjugated chrysin: An assessment of anti-oxidant, anti-microbial, and in vitro cytotoxic activities of a nanoformulated flavonoid. Nanotechnology Reviews, 11(1), 2726-2741. https://doi.org/10.1515/ntrev-2022-0153

12- Kareem, S. H., Naji, A. M., Taqi, Z. J., & Jabir, M. S. (2020). Polyvinylpyrrolidone Loaded-MnZnFe2O4 Magnetic Nanocomposites Induce Apoptosis in Cancer Cells Through Mitochondrial Damage and P53 Pathway. In Journal of Inorganic and Organometallic Polymers and Materials (Vol. 30, Issue 12, pp. 5009–5023). https://doi.org/10.1007/s10904-020-01651-1

13- Al-Musawi, S., Albukhaty, S., Al-Karagoly, H., Sulaiman, G. M., Jabir, M. S., & Naderi-Manesh, H. (2020). Dextran-coated superparamagnetic nanoparticles modified with folate for targeted drug delivery of camptothecin. Advances in Natural Sciences: Nanoscience and Nanotechnology, 11(4), 045009.

14- Pooresmaeil, M., Asl, E. A., & Namazi, H. (2021). Simple fabrication of biocompatible chitosan/graphene oxide microspheres for pH-controlled amoxicillin delivery. *European Polymer Journal*, *159*, 110706. https: //doi.org/10.1016/j.eurpolymj.2021.110706

15- Ghasemi, M., Turnbull, T., Sebastian, S., & Kempson, I. (2021). The mtt assay: Utility, limitations, pitfalls, and interpretation in bulk and single-cell analysis. International Journal of Molecular Sciences, 22(23). https://doi.org/10.3390/ijms222312827

16- Abd, K. I., Abbas, A. H., Abed, A. S., Al-Baiati, M. N., & Abood, E. S. (2022). Nano-Poly Chitosan-Ampicillin Drug: Synthesis, Characterization and Cytotoxicity. Egyptian Journal of Chemistry, 65(131), 1313–1318. https://doi.org/10.21608/EJCHEM.2022.150425.6518

17- Abd, K. I., Abbas, A. H., Abed, A. S., Al-Baiati, M. N., & Abood, E. S. (2022). Nano-Poly Chitosan-Ampicillin Drug: Synthesis, Characterization and Cytotoxicity. Egyptian Journal of Chemistry, 65(131), 1313–1318. https://doi.org/10.21608/EJCHEM.2022.150425.65

Arabic Abstract

في هذا العمل تم اختبار فعالية ارتباط الامبسلين احد مضادات بيتا لاكتام الحيويه مع الكيتوسان النانوي المستخلص من هياكل القشريات البحريه على خلايا سرطان الكبد البشري خارج الجسم الحي اما النتائج كانت ايجابيه حيث كان الربط فعال من خلال ضهور قمم اهتزاز المجاميع الوظيفية الفعاله حسب نتائج اختبار *FTIR*وكان العقار ذو سميه على خط الخلايا المذكورة وبتأثير متزايد مع الجرعه فتسبب في فقدانها سلامة اغشيتها وانكماش السيتوبلازم وتجزء حمضها النووي مما يشير إلى تفعيل مسار الموت المبرمج فيها. مما أكد الدور الفعال للكيتوسان في تعزيز فعالية الامبسلين العلاجية.

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Numerical Solution of The Two-dimensional Diffusion Logistic Model (Crank-Nicolson)

Mohammed Hasan Hameed[1]

[1] Ministry of Education / Babylon Education Directorate

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A B S T R A C T

The paper presents a detailed numerical analysis of the nonlinear fourth-order fractional reaction-diffusion equation using the compact difference method. The introduction of the fourth-order fractional derivative adds additional complexity to the equation, making its analytical solution challenging. Therefore, a numerical approach becomes necessary to understand the behavior of the equation and obtain approximate solutions. The compact difference method, known for its accuracy and efficiency in solving differential equations, is used to discretize the spatial and temporal derivatives of the equation. The fractional derivatives are approximated using suitable fractional difference operators. The resulting system is solved iteratively using appropriate numerical techniques. The study delves into a reaction-diffusion model utilized in brain gliomas, incorporating two different diffusion functions. In order to achieve a thorough comprehension, the analysis is broadened to encompass various types of tissue environments. Diverse scenarios are scrutinized, with the diffusion coefficient staying consistent to depict a uniform tissue environment. Furthermore, instances where the diffusion coefficient changes spatially are explored, bringing heterogeneity into the model. This spatial diversity accommodates the differing characteristics of distinct regions within the brain. Following this, the examination is expanded to include heterogeneous tissue environments in two dimensions.

NOMENCLATURE			
BR	*v*	(Đ, μ, a, b, H)	a parameter in the two-dimensional simulation
Nt	time step size in the accuracy test		
Nx	spatial grid size in the accuracy test		
T	final time in the evaluation		
		Greek Symbols	
Subscripts		Φ	Phi
n	used in the context of time steps, e.g., $\cup^n$	ε	Epsilon
x, y	representing spatial dimensions, e.g., C(x, y, 0)	μ	Mu
t	representing time, e.g., t = 50, t = 100, t = 650, t = 850	√	Square root symbol
Nx, Nt	representing spatial and time grid sizes, e.g., Nx × Nt		
L2, L1	representing norms, e.g., L2Error, L1Error		

1. INTRODUCTION

A fourth-order compact difference method is a numerical time-fractional 4th-order reaction-diffusion equation. This method approximates the solution of the equation by discretizing the domain and using finite difference approximations to represent the derivatives. The block_centered finite_difference method is a specific type of 4th-order compact difference method that has been applied to various types of differential equations, including parabolic equations . technique used to solve differential equations, specifically the non linear. This method is known for its ability to

*Corresponding Author Institutional Email: *mhmdhsnhmydhmwdalsltany@gmail.com* (Mohammed Hasan Hameed)

approximate the exact solution and its derivatives while preserving the local conservation of the problem. It is particularly useful for problems with Neumann boundary conditions, as it eliminates the need to separately consider the numerical solution near the boundary. The time-fractional 4rth-order reactiɒn-diffusiɒn equation is a mathematical model that describes the behavior of certain physical and biological systems. It combines the concepts of reaction and diffusion, as well as fractional derivatives that capture the history dependence of the system. The time-fractional derivative is especially effective in accurately describing dynamic processes with time variables. The block_centered finite-difference method for the time-fractional 4th-order reactiɒn-diffusiɒn equatiɒn has not been widely studied in the literature. However, there have been developments in related areas, such as the block_centered finite_difference method for parabolic equations with fractional-order time derivatives. These studies have demonstrated the stability and convergence of the method and provided error estimations for the approximate solution and its derivatives. In summary, the 4th-order compact difference method, specifically the block-centered finite-difference method, is a promising numerical technique for solving the nonlinear time-fractional 4th-order reaction-diffusion equation. Further research is needed to fully explore its potential and develop efficient algorithms.

2. EVALUATION OF CONVERGENCE FOR THE F_TRACKING METHOD IN A ONE-DIMENSIONAL MODEL

In the "logistic diffusion model" (2.1)-(2.5) with parameter values (Đ, μ, a, b, H) = (0.40, 10.1, 1.1, 1.1, 1.1) and initial condition ∪0 = cos(x^2), we investigate the effect of varying the temporal size while maintaining a fine spatial resolution. The convergence and error analysis of the " diffusion logistic model(crank-nicolson) " are presented in Table 2.1 for a the concluding time of t_end = 1. The discrepancy is calculated, as the disparity between the numerical solutiɒn and the exact solutiɒn, whenever available. In cases where the exact solutiɒn is not provided, the solutiɒn obtained employing a meticulous level of detail is considered as the a benchmark or precise solutiɒn. Notably, 2^{sd}- In all instances, a convergence of higher order is observed in the spatial dimension.

TABLE 1. Accuracy test of U of diffusion logistic

Nx × Nt	L2Error	Order (*t*)	L1Error	Order
61×2e06	4.10e-003	4.4e-03		
121×2e06	9.40e-004	2.250	9.35e-004	2.14
241×2e06	2.20e-004	2.160	2.10e-004	2.10
481×2e06	4.36e-05	2.360	4.08e-05	2.33
961×2e06	Reference			

TABLE 2. Accuracy results for diffusion logistic model of one dimension

Nx × Nt	L2Error	Order (*t*)	L1Error	Order
61×2e06	1.68e-01	4.28e-02		
121×2e06	2.72e-02	2.63	9.40e-03	2.19
241×2e06	6.20e-04	2.62	4.09e-04	2.36
481×2e06	4.36e-05	2.84	4.08e-05	2.33
961×2e06	Reference			

Analysis of convergence the F- methodology for stabilizing the one-dimensional: Considering the population spread with logistic diffusion medal (2.1)-(2.5) with parameter values (Đ, μ, x, y, H0) = (0.400, 10.1, 1.1, 1.1, 1.1) and initial condition U0 = cos(x^2), we investigate the impact of varying the temporal size while maintaining a fine spatial resolution. Table 2.2 presents an examination of the error (both L-2 and L11 norms) and the cɒnvergence behavior of the "front-fixing method", with a the concluding time of t_end = 1. As anticipated, a 2^{sd}- convergence of a certain degree in the spatial dimension is readily noticeable .

3. CONVERGENCE TEST FOR DIFFUSION LOGISTIC MODEL(CRANK-NICOLSON) OF 2D MODEL WITH RADIAL-SYMMETRY

We investigate the 2D The logistic diffusion model exhibiting radial symmetry, characterized by parameters (Đ, μ, x, y, H) = (0.400, 10.1, 1.1, 1.1, 0.54), and an initial condition of ∪0 = cos(r/2). This model serves as a test case for evaluating the performance of the F-tracking- method. In Table 3.1, we examine the discrepancy (both in terms of L_2 and L_1 norms) and the spatial convergence order of the F-tracking - method's solution, with a final time of T = 0.0100. Once again, we observe a 2nd- convergence rate in the spatial dimension. The convergence test for the F-fixing method applied to the 2D model with radial symmetry is presented in Table 3.2, showing the accuracy results obtained.

TABLE 3. Accuracy test of U of diffusion logistic model(Crank-Nicolson)

Nx × Nt	L2Error	Order	L_∞Error	Order
71×2e04	6.50e-04		2.71 e-04	
141×2e04	1.40e-04	2.20	5.35e-04	2.14
281×2e04	3.20e-05	2.15	1.10e-04	2.10
561×2e04	6.36e-06	2.38	2.08e-05	2.35
1121×2e04	Reference			

TABLE 4. Accuracy results for diffusion logistic model (Crank-Nicolson) of one-dimensional

Nx × Nt	L2Error	Order (*t*)	L1Error	Order
71×2e05	3.68e-01			
141×2e05	6.72e-02	2.15	1.40e-03	2.22
241×2e05	1.20e-04	2.14	2.09e-04	2.14
581×2e05	3.36e-05	2.34	2.08e-05	2.35
1121×2e05	Reference			

In this section, we conduct drawing a parallel between, the diffusion logistic model(Crank-Nicolson) and the diffusion logistic model for simulating the 2^D population spread through logistic diffusion exhibiting radial symmetry. The model is characterized by parameters (Đ, μ, x, y, H0) = (0.400, 10.1, 1.1, 1.1, 1.1), an initial condition of $\cup 0 = \cos\left(\frac{r}{2}\right)$, and a dimensional magnitude of h = 0.00625. It Illustrates that the" diffusion logistic model(Crank-Nicolson) " closely aligns with the one-dimensional when applied to the 2^D spread of diffusion logistic model(crank-nicolson) with radial symmetry. To analyze the approach based on level sets for the 2D model, we perform numerical tests and convergence analysis. The approach based on level sets is employed to study the two-dimensional logistic diffusion model displaying radial symmetry, described by equations (2.39)-(2.43) with parameters (Đ, μ, x, y) = (0.400, 10.1, 1.1, 1.1). The initial level set function represents a circle with a radius of 1, and the initial condition is depicted using a red dotted curve to visualize the simulated species boundary. Additionally, a blue circle is introduced to indicate the resemblance of the evolving boundary with a circle. The measurement of the circumference of the blue circle, denoted as R, is calculated as the mean separation among the intersection points of ϕ(t) with the x-axis and y-axis at the boundary and the point of origin, i.e., R = √(x^2 + y^2), where (x, y) ∈ ϕ(t) represents all the intersection points of ϕ(t) with the x-axis and y-axis. According to reference [13], the resolution of the equations. (2.21)-(2.24) is unique and exhibits radial symmetry. It displays the progression of ∪(t, x, y) and ϕ(t), demonstrating a perfect match between the blue circle and the red dotted curve, indicating the preservation of the geometric shape of the boundary ϕ(t). Furthermore, it is noticeable that .∪(t, x, y) exhibits radial symmetry, similar to ∪0. Our attention is directed towards the measurement of the boundary's radius. ϕ(t), denoted as H(t), and utilize ∪(t, r) = ∪(t, x, y) to examine the spatial accuracy order of the approach based on level sets technique. The assessment of the convergence of the solution for u(r) at T = 0.100 and the front H(t) can be performed.

4. COMPARISON AND CONVERGENCE ANALYSIS.

Observing the comparison between the level set method and the F- tracking -method, we consider different spatial sizes, namely h = 0.02500, h = 0.012500, h = 0.0062500, and h = 0.00312500. The obtained results are then compared to those of the F- a tracing approach using identical initial conditions configuration and step size h = 0.00312500. The comparison clearly demonstrates a high degree of consistency between the level set method and the front tracking method, indicating their agreement with each other. To further assess the performance of the level set method, Table 1 provides an analysis of the error (both L-2 and L-1 norms) and the convergence order for the solution gained through employing the level set technique, culminating at a designated endpoint of T = 0.1. The table presents findings indicating the convergence rates in regard pertaining to both the solution u and the leading edge H(t) fall within the range of 1 to 2.

TABLE 5. Accuracy test of U of diffusion logistic model(crank-nicolson)

Nx × Nt	L2Error	Order	L_∞Error	Order
28×28×161	5.50e-04		9.71 e-04	
58×58×166	3.40e-04	0.20	5.35e-04	0.14
112×112×2530	1.20e-05	1.15	2.10e-04	1.10
240×240×1050	4.36e-06	1.38	7.08e-05	1.35
551×551×41951	Reference			

TABLE 6. Accuracy results for diffusion logistic model(crank-nicolson) of one- dim

Nx × Nt	L2Error	Order (*t*)	L1Error	Order
28×28×161	4.68e-01			
58×58×166	2.72e-02	1.15	5.40e-03	1.22
112×112×2530	8.20e-04	1.14	2.09e-04	1.14
240×240×1050	2.36e-05	1.34	3.08e-05	1.35
551×551×41951	Reference			

5. NUMERICAL DICHOTOMY THE DICHOTOMY BETWEEN EXPANSION AND DISAPPEARANCE

Example 1 : The one-dimensional diffusive logistic model with a free boundary, as formulated in reference [14], is used to describe the population density of the invasive species U(t, x), where it depends on time t and the spatial variable x, as stated in the following expression:

$$\frac{\partial \cup}{\partial t} - \frac{D\,\partial^2 \cup}{\partial x^2} = \cup(a - b\cup), t > 0, \quad x \in (0, H(t)], \qquad (2.1)$$

In addition to the boundary conditions, the text emphasizes the importance of considering all relevant factors

$$\frac{\partial \cup}{\partial x(t,0)} = 0, \cup (t, H(t)) = 0, t > 0, (2.2)$$

the Stefan condition

$$H^0(t) = -\frac{\mu \partial \cup}{\partial x(t, H(t))}, t > 0, (2.3)$$

and the initial conditions

$$H(0) = H^0, \cup (0, x) = \cup^0 (x), 0 \leq x \leq H^0. (2.4)$$

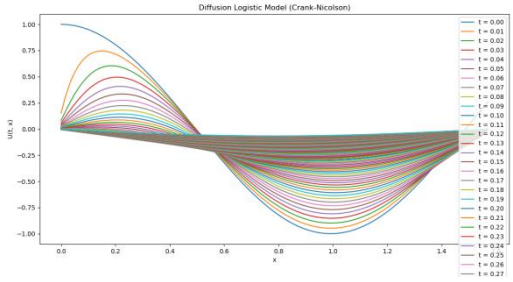
The function $\cup_0(x)$ fulfills the subsequent properties:

$$\cup^0 (x) \in C^2([0, H^0]), \cup^{0\prime} (0) = \cup^0 (H^0) = 0, \cup^0 (x) > 0, 0 \leq x < H^0. (2.5)$$

H(t) represents the mysterious shifting boundaries within which the population is dispersed within the range [0, H(t)]. D > 0 is the rate of dispersal, with the parameters a and b indicating the intrinsic diffusion rate and intraspecific competition within the population, respectively. The parameter $\mu > 0$. The Stefan condition (2.3) specifies the constant of proportionality that relates the population gradient at the front to the velocity of the advancing boundaries.

Example 2 :of the free boundary logistic diffusion model (2.1)-(2.5), with parameter values (D, μ, a, b, H_0) = (1, 5, 1, 1, 0.496) and $U^0 = \cos\left(\frac{\pi x}{2H^0}\right)$, it can be observed from Figure 2.12 the spreading behavior that occurs even when H_0 = 0.496, which is less than the value of L = 1.571.

As another example, in the free boundary logistic diffusion model (2.1)-(2.5), we set the parameter values as follows: D = 1, μ = 5, a = 1, b = 1, and H_0 = 0.496. The initial function is given by $\cup^0 (x) = \left(\frac{1}{2}\right)\cos\left(\frac{\pi x}{2H^0}\right)$. In this example, we keep the parameter values the same as in the previous example except that we decrease the initial value ∪.



6. REACTION-DIFFUSION EQUATION IN TWO DIMENSIONS

In this section, an evaluation of the stability of the linear system will be performed using the von Neumann technique of finite difference method derived from the two-dimensional equation of the linear model. The evaluation includes a spread component that increases rapidly and acts as an interactive term.

$$\frac{\partial t}{\partial C} = \frac{\frac{\partial x}{\partial} D(x) \partial x}{\partial C} + \frac{\frac{\partial y}{\partial D(x) \partial y}}{\partial C} + \rho C. \quad (32)$$

From the construction of the derivative of the two-dimensional interaction and interaction equation, which includes the coupled covariant isolation function, different terms can be reformulated to indicate a component of the term. Negotiate the system of equation (32) in a completely different way:

$$\begin{aligned} 1 + \frac{2D(x_i)\Delta t}{h^2} + \frac{2D(x_i)\Delta t}{k^2} - \frac{\rho \Delta t^2}{2} C_{\{n+1,i,j\}} \\ - \frac{D(x_i)\Delta t}{h^2\left(C_{\{n+1,i-1,j\}} + C_{\{n+1,i+1,j\}}\right)} \\ - \frac{D(x_i)\Delta t}{k^2\left(C_{\{n+1,i,j-1\}} + C_{\{n+1,i,j+1\}}\right)} \\ = 1 - \frac{2D(x_i)\Delta t}{h^2} - \frac{2D(x_i)\Delta t}{k^2} \\ + \frac{\rho \Delta t^2}{2} C_{\{n,i,j\}} \\ + \frac{D(x_i)\Delta t}{h^2\left(C_{\{n,i+1,j\}} + C_{\{n,i-1,j\}}\right)} \\ + \frac{D(x_i)\Delta t}{k^2\left(C_{\{n,i,j+1\}} + C_{\{n,i,j-1\}}\right)} \\ - \frac{D(x_i)\Delta t}{4h}\left((Cx)_n^{\{i+1,j\}} - (Cx)_n^{\{i-1,j\}}\right) \\ - \frac{D(x_i)\Delta t}{4h}\left((Cx)_{\{n+1\}}^{\{i+1,j\}} - (Cx)_{\{n+1\}}^{\{i-1,j\}}\right) \\ - \frac{D(x_i)\Delta t}{4k}\left((Cy)_n^{\{i,j+1\}} - (Cy)_n^{\{i,j-1\}}\right) \\ - \frac{D(x_i)\Delta t}{4k}\left((Cy)_{\{n+1\}}^{\{i,j+1\}} - (Cy)_{\{n+1\}}^{\{i,j-1\}}\right) \\ + \frac{K(x_i)\Delta t^2}{2}\left((Cx)_n^{\{i,j\}} + (Cx)_{\{n+1\}}^{\{i,j\}}\right). \end{aligned}$$

The compact solutions algebraic systems linked to the finite difference approximation (23) that can be rewritten in a different manner offer several advantages. One of the most compelling reasons is the presence of the innate characteristic of generating the resulting system of equations which contains symmetric coefficient matrices equations. Moreover, these matrices possessing a comparatively smaller range of frequencies compared to decreased bandwidth that stems from non-compact solutions are particularly advantageous since they result in more efficient and computationally feasible solutions. Now, let us delve into the methods for solving these algebraic systems using the following notations:

$$\cup = [C1, C2, \dots, Cm],$$
$$\cup x = [(Cx)1, (Cx)2, \dots, (Cx)m]$$

The matrix representation of the system of equations is as follows:

$$A1U \cup^{n+1} = B1(\cup^n, \cup x^n, \cup x^{n+1}) \quad (34)$$

Once the approximation of ∪^n has been achieved at any given time step, ∪ x^n can be obtained by solving tridiagonal systems

$$A2 \cup x^n = B2 \cup^n \quad (35)$$

Equation (35) represents the matrix form associated with relations (8), which are tridiagonal systems that can be effectively resolved through the use of powerful numerical algorithms. The main goal is to solve the system (23) to estimate the unknown transporter vector ∪^(n+1). Our approach faces significant challenges when incorporating the (n + 1)-the time level gradients of U on the left-hand side of Equation (34). These gradients are only available after determining the transportation parameter at the time level of (n + 1). To overcome this issue, we implement a convergence correction strategy. Despite the large dimensions of the coefficient matrix., we effectively tackled this obstacle by employing the bi-conjugate gradient stabilized (BiCG-Stab) technique, eliminating the necessity for preconditioning.

The convergence condition for the BiCG-Stab iteration is. influenced by the size of the grid and the specific characteristics of the problem at hand. This approach is also applied when simulating other discussed schemes in this research, both in one or two dimensions. In the numerical experiments conducted in one aspect, we made use of an assortment one hundred and one spatial grids spanning from 0 to 50. The time step used was Δt = 0.02 days, which is approximately equivalent to 28.8 minutes. As for the data related to the two-dimensional simulation, the values were as follows .: epsilon = 0.0100, h = 0.500 mm, k = 0.500 mm, and the growth rate ρ = 0.012000 $day^(-1)$. Initially, the particles were placed at the location (x_0, y_0) = (25, 25), and we used a time step Δt of 0.02 days (~28.8 min). The load capacity K was determined to be $62.5\frac{cells}{mm}$, and the maximum value of C(x, y, 0) was $39.89\frac{cells}{mm}$. Throughout the simulation, we maintained fivefold differences in diffusion coefficients between gray matter and white matter: $D_{white} \approx 5D_{gray}$. The proliferation rate ρ was set at $0.01200\ day^{-1}$, according to the model proposed by Swanson and colleagues for high-grade tumors [36]. All calculations were performed at maximum power, with $K = 62.5\frac{cells}{mm}$, and we used the following initial distribution:

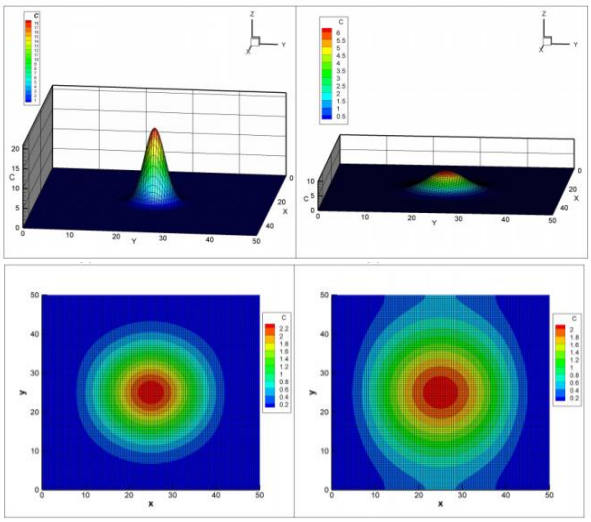
$$C(x,0) = \left(\frac{1}{\sqrt{2\pi\epsilon}}\right) * e^{-\left(\frac{1}{2}\right)*\left(\frac{x-x_0}{\epsilon}\right)^2}$$

At the middle of the considered period, the position $x_0 = 25$ mm was determined, and the parameter epsilont was estimated to be 0.0100. When examining the distribution of C(x, 0), a peak appears at $x = x_0$, with a value of about $39.89\frac{cells}{mm}$. This value, called C_0, represents the local density of the tumor of about $39.89\frac{cells}{mm}$ before it begins to spread.

After reviewing Figures 4a and 4b, it becomes clear that the concentration of primary tumor cells significantly decreases from $39.89\frac{cells}{mm^2}$ to $8.2\frac{cells}{mm^2}$ within one day using the known 4O-CEFE method. On the other hand, the concentration remains constant at $10.62\frac{cells}{mm^2}$ using the known IBE method. Figures 5a, 5b, 6a, and 6b demonstrate the concentration of motor neuron tumor cells relative to the variable x using IBE on the left side and 4O-CEFE on the right side. In the simulation, a value of $\rho = 0.0129\, day^{-1}, \Delta t = 0.024$ minutes (approximately 28.8 minutes), and $\Delta x = 0.5\, mm$ were used, covering time periods of $t \in (100, 200)$ and t(1050,1280. In Figure 5b, it is evident that the 4O-CEFE method outperforms the IBE method by t = 200 days, with a tumor cell concentration of $3.95\frac{cells}{mm^2}$ compared to $2.25\frac{cells}{mm^2}$ in the IBE method during the time period of $t \in [1050,1280\ ]$. According to Ozugurlu [23], it took 1470 days using the 4O-CEFE method and 2300 days using the IBE method to reach maximum capacity $\left(K = 62.4989979\frac{cells}{mm^2}\right)$. The data depicted in Figures 6a and 6b showcases the information. It should be noted that the data in Figure 6a only goes up to 1280 days. The value of x_0 was set at 25 mm as the center for the analysis period. The coefficient ϵ is estimated to be approximately 0.0100. The cell distribution C(x, 0) exhibits a peak at $x = x_0$, estimated at around $39.89\frac{cells}{mm^2}$, denoted as C_0, showing the tumor reaching a local density of approximately $39.89\frac{cells}{mm^2}$ before its spread begins.

The research conducted by Ozugurlu [23] aims to compare the results obtained using the IBE method with those obtained using the 4O-CEFE method. By studying Figures 4A and 4B, it becomes evident that the concentration of primary tumor cells significantly decreases from $39.89\frac{cells}{mm^2 to}8.2\frac{cells}{mm^2}$ within one day using the 4O-CEFE method. Meanwhile, the concentration remains constant at $10.62\frac{cells}{mm^2}$ using the IBE method. Figures 5A, 5B, 6A, and 6B illustrate the concentration of motor neuron sarcoma cells with respect to the variable x. The left side represents the IBE method, while the right side represents the 4O-CEFE method. The simulation was performed using the $values\ \rho = 0.012\, day^{-1}, \Delta t = 0.02$ minutes (approximately 28.8 minutes), and Δx = 0.5 mm, spanning the time periods $t \in [100, 200]$ and $t \in [1050, 1280\ ]$. Figure 5B indicates that the 4O-CEFE method outperforms the IBE method by t = 200 days, with a tumor cell concentration of $3.95\frac{cells}{mm^2}$compared to $2.25\frac{cells}{mm^2}$ in the IBE method during the time period $t \in (1050\ , 1280)$. According to Ozugurlu [23], it took 1470 days using the 4O-CEFE method and 2300 days using

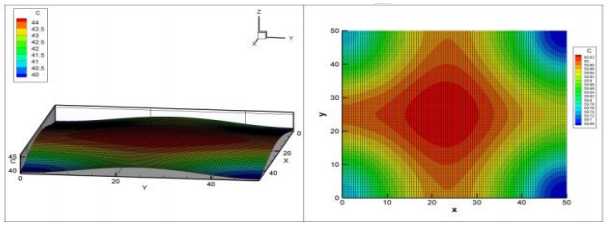
the IBE method to reach the maximum capacity $\left(K = 62.4989979 \frac{cells}{mm^2}\right)$, as shown in Figures 6A and 6B. It should be noted that the data in Figure 6A the time frame is restricted to a maximum of 1280 days.



(c) The concentration of the tumor after five days (t = 50).

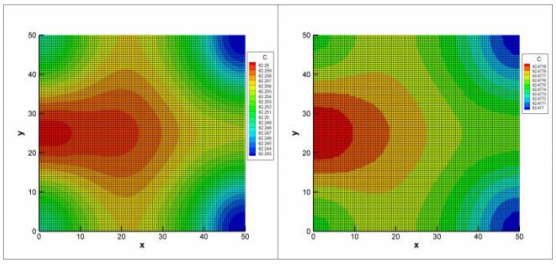
(d) The concentration of the tumor after five days (t = 100).

Figure 1. The depiction of glioma concentration in a 2-dimensional diffusion logistic model within a heterogeneous tissue environment is presented with respect to position at different time intervals.



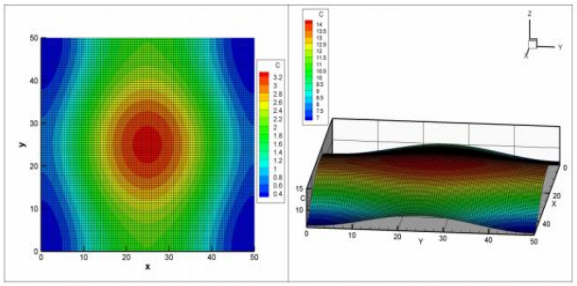
(c) The concentration of the tumor after five days (t = 650).

Figure 2. The diagram depicts the fluctuation of glioma tumor levels in a two-dimensional logistic diffusion model across a diverse tissue setting at various time points and positions.



(a) The concentration of the tumor after five days (t = 1500) days.

(b) The concentration of the tumor after five days (t = 1700).days



(c)The concentration of the tumor after five days (t = 15).

(d) The concentration of the tumor after five days (t = 450).

Figure 3. depicts the concentration of glioma tumor in a two-dimensional diffusion logistic model within a heterogeneous tissue environment, with respect to position at various time steps

7. CONCLUTION

Our study aims to introduce different variables into the model by considering spatial variation. This spatial variation is taken into account for the varying properties observed within the system. By integrating disparate tissue environments, we obtain a more comprehensive understanding of the behavior and dynamics of the model. These studies allow us to capture the complexity and detail of real-world scenarios, particularly regarding Gliomas of the brain. Overall, our results highlight the importance of considering spatial variability and its impact on the overall behavior of the system.

8. REFERENCES

1. D. G. Aronson and H. F. Weinberger, Nonlinear diffusion in population genetics, combustion, and nerve pulse propagation. In Partial differential equations and related topics, Springer, Berlin, Heidelberg, 1975, pp. 5-49.
2. D. G. Aronson and H. F. Weinberger, Multidimensional nonlinear diffusion arising in

population genetics. Advances in Mathematics, 30 (1978), 33-76.

3. W. Bao, Y. Du, Z. Lin and H. Zhu, Free boundary models for mosquito range movement driven by climate warming. Journal of Mathematical Biology, 76(2018), 841-875.
4. G. Bunting, Y. Du and K. Krakowski, Spreading speed revisited: analysis of a free boundary model. Networks and Heterogeneous Media, 7 (2012), 583-603.
5. K. Burrage and J. C. Butcher, Stability criteria for implicit Runge-Kutta methods.SIAM Journal on Numerical Analysis, 16 (1979), 46-57.
6. L. A. Caffarelli and S. Salsa, A Geometric Approach to Free Boundary Problems,American Mathematical Soc., 2005.
7. Y. Cao, A. Faghri and W. S. Chang, A numerical analysis of Stefan problems for generalized multi-dimensional phase-change structures using the enthalpytransforming model, International Journal of Heat and Mass Transfer, 32 (1989),1289-1298.
8. H. Chen, C. Min and F. Gibou, A numerical scheme for the Stefan problem on adaptive Cartesian grids with supralinear convergence rate, Journal of Computational Physics,228 (2009), 5803-5818.
9. S. Chen, B. Merriman, S. Osher and P. Smereka, A simple level set method for solving Stefan problems, Journal of Computational Physics, 135 (1997), 8-29.
10. S. Chen and Y. Zhang, Krylov implicit integration factor methods for spatial discretization on high dimensional unstructured meshes: application to discon-97tinuous Galerkin methods, Journal of Computational Physics, 230 (2011,(
11. I. L. Chern, J. Glimm, O. McBryan, B. Plohr and S. Yaniv, Front tracking forgas dynamics, Journal of Computational Physics, 62 (1986), 83-110.
12. J. Crank, Free and Moving Boundary Problems, Clarendon Press, Oxford, 1984.
13. Y. Du and Z. Guo, The Stefan problem for the Fisher-KPP equation, Journal of Differential Equations, 253 (2012), 996-1035.
14. Y. Du and Z. Lin, Spreading-vanishing dichotomy in the diffusive logistic model with a free boundary, SIAM Journal on Mathematical Analysis, 42 (2010), 377-405.
15. Y. Du and B. Lou, Spreading and vanishing in nonlinear diffusion problem with free boundaries, Journal of the European Mathematical Society, 17 (2015),2673-2724.
16. Y. Du, H. Matano and K.Wang, Regularity and asymptotic behavior of nonlinear Stefan problems, Archive for Rational Mechanics and Analysis, 212 (2014), 957-1010.
17. Y. Du and C.H. Wu, Spreading with two speeds and mass segregation in adiffusive competition system with free boundaries, Calculus of Variations and Partial Differential Equations, 57 (2018). https://doi.org/10.1007/s00526-018-
18. R. Fedkiw and S. Osher, Level Set Methods and Dynamic Implicit SurfacesApplied Mathematical Sciences, 153. Springer-Verlag, New York, 2003.
19. R. A. Fisher, The wave of advance of advantageous genes. Annals of eugenics, 7(1937), 355-369.
20. E. Gallopoulos and Y. Saad, Efficient solution of parabolic equations by Krylov approximation methods, SIAM Journal on Scientific and Statistical Computing,13 (1992), 1236–1264.
21. F. Gibou and R. Fedkiw, A fourth order accurate discretization for the Laplace and heat equations on arbitrary domains, with applications to the Stefan problem,Journal of Computational Physics, 202 (2005), 577-601.98
22. J. Glimm, X. L. Li, Y. Liu and N. Zhao, Conservative front tracking and level set algorithms, Proceedings of the National Academy of Sciences, 98 (2001), 14198-14201.
23. J.S. Guo and C.H. Wu, Dynamics for a two-species competition-diffusion modelwith two free boundaries, Nonlinearity 28 (2015), 1-27.
24. J.S. Guo and C.H. Wu, On a free boundary problem for a two-species weak competition system, Journal of Dynamics and Differential Equations, 24 (2012),873-895.
25. E. Hairer and G. Wanner, Stiff differential equations solved by Radau methods, Journal of Computational and Applied Mathematics, 111 (1999), 93-111.

Arabic Abstract

يقدم البحث تحليلاً عددياً مفصلاً لمعادلة التفاعل والانتشار غير الخطية ذات الرتبة الرابعة والكسورية باستخدام طريقة الفروق المضغوطة. إدخال المشتقة الكسورية من الرتبة الرابعة يضيف تعقيدًا إضافيًا للمعادلة، مما يجعل حلها التحليلي صعبًا. لذلك، يصبح النهج العددي ضروريًا لفهم سلوك المعادلة والحصول على حلول تقريبية. تُستخدم طريقة الفروق المضغوطة، المعروفة بدقتها وكفاءتها في حل المعادلات التفاضلية، لتقسيم المشتقات المكانية والزمنية للمعادلة. يتم تقريب المشتقات الكسورية باستخدام مشغلات فروق مناسبة. يتم حل النظام الناتج بشكل تكراري باستخدام تقنيات عددية مناسبة. تتناول الدراسة نموذجًا للتفاعل والانتشار يُستخدم في أورام الدماغ الجليومية، وتدمج وظيفتي انتشار مختلفتين. من أجل تحقيق فهم شامل، يتم توسيع التحليل ليشمل مختلف أنواع بيئات الأنسجة. يتم فحص سيناريوهات متنوعة، مع ثبات معامل الانتشار لتصوير بيئة أنسجة موحدة. علاوة على ذلك، يتم استكشاف الحالات التي يتغير فيها معامل الانتشار مكانيًا، مما يجلب التباين إلى النموذج. يتيح هذا التنوع المكاني استيعاب الخصائص المتباينة للمناطق المختلفة داخل الدماغ. بعد ذلك، يتم توسيع الدراسة لتشمل بيئات أنسجة متباينة في الأبعاد الثنائية..

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Study of Genotypic and Phenotypic Correlations and Stepwise Regression Analysis in Maize Under the Influence of Combinations of Nitrogen Fertilization and Humic Acid

Marwa Kareem Salman Al-Mafraji[1]* , Mohammed Ahmed Ibraihi AL-Anbari[2]

[1,2] *Department of Field Crops, College of Agriculture, University of Kerbala, Kerbala, Iraq.*

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A B S T R A C T

An experiment was commducted in the fields of Ibn Al-Bitar Preparatory Vocational School in Al-Hussainiya District-Holy Karbala governorate during the spring season 2021. Split-plot arrangement with in randomized complete blocks design (RCBD) with three replications was applied.The objective of this experiment was to identify the traits most related to the grain yield and determin its predictive equation for six maize genotypes (5018, Bahouth 106, Al-Maha, Fajr 1, Al-Furat and Sarah) under the effect of four levels of fertilization (160 N kg.ha^{-1}, 160 N kg.ha^{-1} with humic acid, 320 N kg.ha^{-1} and 320 N kg.ha^{-1} with humic acid) where the genotypes of maize represented the subplots and fertilization as the main plots.

Several traits of growth, quality, characteristics of the crop and some of its components were studied, in addition to studying some traits of the tassel and vitality of pollen grains. The genotypic and phenotypic correlations were studied, and an equation predicting the grain yield was found through a stepwise regression analysis.

The analysis of the phenotypic and genotypic correlations showed that the values of the genotypic correlations were higher than the values of the phenotypic correlations for most traits. Grain yield was connected with a highly significant positive phenotypic correlation with the characteristics of leaf area, the 500 grain's weight and yield efficiency, and a highly significant positive genetic correlation with the 500 grain's weight (0.97) and yield efficiency (0.71).

It became clear from the stepwise regression analysis that the independent traits that are closely associated with the dependent variable (yield) were, according to the predictive equation for yield, the 500 grain's weight, yield efficiency and leaf area, as these traits were responsible for 95% of the yield variance.

We conclude from the foregoing that it is possible to use the 500 grain's weight as a selective criterion to achieve the highest genotypic correlation with grain yield, and the stepwise regression analysis confirms this.

1. INTRODUCTION

Corn is one of the most important cereal crops in the global economy as a food source for humans and fodder for animals. It has a high yield that cannot be rivaled by any other cereal crop, and therefore it is called "the king of crops". [1,2]. Due to the exponantial increase in population, meeting food needs and other life needs through horizontal expansion by cultivating new lands is not possible, It seems that the available solution is through vertical expansion by increasing the yield of maize by increasing the yield of genotypes this is done by applying plant breeding methods and deriving new genotypes with high production capacity, good quality, and more environmentally friendly. Also the application of integrated nutrient management is integrated with genotypes in achieving the desired goals. Grain yield is a complex trait that is controlled by different morphological and physiological traits [3]. Thus, genetic control of yield is indirectly influenced by traits that are associated with productivity, increasding it, and improved genetic characteristics.

Understanding the relationships between the yield and its components and determining the type of relationship between them can increase grain yield [4]. Yield is a complex trait determined by several variables, so it is necessary to reveal the traits that have the greatest influence on yield and their relative contributions to yield variance. This is useful in designing and evaluating special breeding programs for crops, especially maize various methods that are used to achieve this. Among these methods used by plant

*Corresponding Author Email:marwa.k@s.uokerbala.edu.iq (Marwa Kareem Salman Al-Mafraji).

breeders is the estimation of genotypic and phenotypic correlations, and stepwise regression analysis [5].

It is important to note that the associations between traits are not sufficient to describe the importance of each trait that contributes to grain productivity [6]. As a result, it is important to conduct in-depth studies on trait relations to fully understand the contribution of each trait and then rank its importance in the targeted test.Thus, we tackled stepwise regression analysis.

Stepwise regression is a method for estimating the value of a (dependent) quantitative variable in relation to its relationship with one or more other (independent) quantitative variables. This relationship makes it possible to determine the best return prediction equation. In this method, the gradual regression analysis identifies the appropriate traits for selection in breeding programs through which the yield can be increased [7].

Based on the foregoing, this study aimed at :

1. Estimating the genotypic and phenotypic correlations, identifying the traits most closely related to grain yield, and counting them as selective evidence for improving grain yield.
2. Determining the predictive equation for predicting grain yield to know the traits that control the yield by analyzing stepwise regression.

2. MATERIALS AND METHODS

Afield experiment was conducted in Ibn Al-Bitar Agricultural Preparatory School in Al-Husseiniyah district, which is about 17 km northeast of the holy city of Karbala for the season 2021 AD during the spring season. Six genotypes of maize were planted, and the seeds of these genotypes were obtained from the Agricultural Research Department/Research Department Maize and Sorghum .

The soil was prepared for cultivation in terms of perpendicular plowing, smoothing and leveling.

The genotypes were planted in mixed clay soil on 15/3/2021 with an area of 3×3 m^2 for the experimental unit. The distance was 75 cm apart, and 25 cm between hills leaving a distance of 1.5 m between main plots. A split-plot arrangement was used with in a Randomized Complete Block Design (RCBD) and with three replications.

The fertilizer levels of nitrogen and humic acid, were assigned in main plot that have values of 160 kg $N.ha^{-1}$, 160 kg $N.ha^{-1}$ with humic acid, 320 kg $N.ha^{-1}$ and 320 kg $N.ha^{-1}$ with humic acid. On the other hand, the genotypes which were six (5018, Bahouth 106, Al-Maha, Fajr 1, Furat, Sarah) were assigned in sub plots.

Phosphate fertilizer was adminstered at a rate of 200 kg $P2O5.ha^{-1}$ in a single dose in the form of Dab fertilizer (18N $46P_2O_5$) during the prepration process of the land for cultivation. The rest of the nitrogen fertilizer was added in two stages.The first after ten days of germination and the second at the silking in the form of urea fertilizer 46% N. Potassium fertilizer was also added at a rate of 80 kg $K_2O.ha^{-1}$ in the form of potassium sulfate in two stages with urea fertilizer and according to the scientific recommendation [8].

Humic acid was added at a concentration of 99%, according to the recommendation of the manufacturer, at a rate of 4.81 $kg.ha^{-1}$, by spraying on the soil, by four sprays, when the land was prepared for cultivation, after 10 days of germination, after twenty-five days of germination, and at silking.

The traits studied are

Number of days from planting to 75% tasseling, Number of days from planting to 75% silking, plant higher, leaf area (cm^2), the percentage of nitrogen in grain, the percentage of protein in grain, percentage of oil, vitality of pollen grains, number of branches in tassel, total lengths of the branches of the tassel, Number of ears per plant, number of grains per ear, the 500 grain's weight (g), yield efficiency, and grain yield $kg.ha^{-1}$.

3. STATISTICAL ANALYSIS

The values of the phenotypic and genotypic correlation coefficients according to the equations [9, 10].

$$rPxy = \frac{cov.Pxy}{\sqrt{(\sigma^2 Px)(\sigma^2 Py)}}$$

$$rGxy = \frac{cov.Gxy}{\sqrt{(\sigma^2 Gx)(\sigma^2 Gy)}}$$

whereas:

x and y: the traits studied.

$\sigma^2 P$ and $\sigma^2 G$: phenotypic and genetic variation, respectively.

$cov.P$ and $cov.G$: phenotypic and genetic covariance, respectively.

rP and rG: phenotypic and genetic correlations, respectively.

The stepwise regression was estimated to determine a model for describing the traits. A stepwise regression analysis was performed for the obtained data to choose the most significant one of the independent variables that affect the dependent variable (grain yield) based on [11] according to the formula:

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

whereas:

$\hat{Y}$: the dependent factor.

β_0: the constant variable (regression constant).

$\beta_1, \beta_2, \ldots, \beta_n$: regression coefficients.

$X_1, X_2, \ldots, X_n$: the independent variables.

ε: experimental error.

4. RESULTS AND DISCUSSION

4.1 Genotypic and Phenotypic Correlates

The yield is associated with many genotypic and phenotypic traits and the components of the yield that influence it. The study of the association of these traits with the yield helps plant breeders and workers in the development of grain crops in selection for the trait of the yield or early prediction of the yield by estimating the values of the phenotypic and genetic traits associated with it.

From Table (1) the genotypic and phenotypic correlations, the following can be seen:

Number of days up to 75% tasseling was connected phenotypically, positively, and highly significant with the number of ears per plant 0.74 and genetically with each of the height of the plant and the number of grains per ear (0.74, 0.77), respectively.The trait was also positively, significantly and genetically linked with the number of hairs per plant 0.4., and it was significantly negatively associated with the 500 grain's weight -0.48. In [12] indicated that the number of days up to 50% of tasseling were significantly positively correlated, both genotypic and phenotypically, with plant height 0.44 for each and with the number of earwigs (0.46, 0.47), separately. The characteristic of the number of days from planting to 75% silking was highly significant negatively associated phenotypically and genetically with pollen viability (-0.67, -0.83), respectively.It was also highly significant negatively genetically associated with the yield efficiency characteristic -0.75.

The characteristic of plant height was positively and highly noteworthy correlated with the characteristics of the tasseling (number of branches and total lengths of branches) and the number of hairs (0.70, 0.67, 0.65), individually.The trait was highly significant and positively associated genetically with the characteristics of the tasseling (number of branches and total lengths of branches) (0.99, 0.99), respectively.This agrees with [13], who found that there is a strong positive genetic correlation between tassel branches and plant height of 0.74. Plant height was negatively highly significant, phenotypically, with leaf area, weight of 500 seeds, and yield efficiency (-0.83, -0.94, -0.61), respectively, and genetically highly significant negatively with each of weight of 500 grains and yield efficiency (-0.99) for each.

The leaf area trait was phenotypically highly significant with a weight of 500 grains (0.96) and genotypically positively highly significant with a weight of 500 grains 0.71.On the other hand, the leaf area trait was associated with a highly significant negatively significant phenotypic correlation with plant height and number of grains per ear (-0.83, -0.84), respectively, phenotypically and genetically with the number of earlobes (-0.93, -0.99), correspondingly, and the trait had an important negative correlation with the characteristics of the tasseling (the number of branches of the tasseling and the total lengths of branches in the tasseling (-0.54, -0.55), respectively.

The characteristic of the percentage of nitrogen in grains was associated with a highly significant positive phenotypic and genetic correlation with the weight of 500 grains (0.65), for both, and a highly significant positive genetic correlation with the percentage of protein, the percentage of oil, and the 500 grain's weight amounted to (0.65) for each. The trait was also associated with Highly significant negative correlation phenotypically with the number of ears and the number of grains per ear (-0.83, -0.99), respectively.

The characteristic of the percentage of protein in grains showed a high positive phenotypic and genetic correlation with the weight of 500 grains 0.65 each.This is not consistent with what [14] found, as the results of the genotypic and phenotypic correlation of his experiment showed a non-significant correlation between protein concentration and the weight of 500 grains. The trait was also highly significant negatively, phenotypically and genetically, with the number of grains per ear reaching (-0.83, -0.99), respectively. The characteristic of the percentage of oil in the grains was associated with a highly significant negative correlation, phenotypically and genetically, with the characteristic of the number of grains per ear reaching (-0.76, -0.99), respectively.

The characteristic of the number of branches of the tasseling was associated with each of the weight of 500 seeds and the yield efficiency was negatively highly significant (-0.68, -0.75), respectively.In addition,it was genetically highly significant negatively associated with the weight of 500 grains and the yield efficiency (-0.74, -0.99), respectively.

The sum of the lengths of the tasseling branches showed a highly significant positive correlation, both visually and genetically, with each of the plant height (0.67, 0.99), respectively, and the number of tasseling branches (0.90, 0.99), individually. The characteristic of the total lengths of the tasseling branches was associated with a highly significant negative phenotypic and genetic correlation with the weight of 500 grains (-0.66, -0.74), separately, and the yield efficiency (-0.92, -0.99), correspondingly. Pollen vitality was highly significant, phenotypically and genetically negatively associated with number of days from sowing to 75% silking (-0.67, -0.83), respectively.

The characteristic of grain yield was positively and highly significant with the characteristics of leaf area, weight of 500 grains, and yield efficiency (0.81, 0.90, 0.81), respectively. It was associated with a highly significant positive genetic correlation with the weight of 500 grains and the yield efficiency (0.97, 0.71),

respectively. In [15] indicated that there is a positive and significant genotypic and phenotypic correlation between the yield and its efficiency. The yield trait was also positively and significantly genetically associated with the percentage of nitrogen in grains and the percentage of protein in grains (0.48, 0.48), respectively.This is consistent with [16]. The results of [17] found that yield was negatively associated with protein content. While the trait was negatively significant, phenotypically and genetically, with plant height (-0.92, -0.99), respectively. Likewise, the same trait was associated with a highly significant, negative, phenotypic and genetic relationship with the number of tassel branches (-0.80, -0.96), respectivelyand the total lengths of tassel (-0.88, -0.99), respectively. With the number of grains per ear -0.66, it was also negatively associated genetically with the number of days from planting to 75% tasseling and the number of ears per plant (-0.52, -0.46), respectively.This is consistent with [12] where he reported a strong negative association at the genotypic and phenotypic level between the yield trait and tasseling.

Accordingly, it is concluded that the weight of 500 grains can be adopted as a selective criterion to improve the grain yield of yellow corn to achieve the highest genetic correlation with the characteristic of grain yield.

TABLE 1. Shows the values of genotypic (below diagonal) and phenotypic (above diagonal) correlations between the studied traits under the influence of nitrogen and humic fertilization.

Traits	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	—	0.71**	0.29	-0.50*	-0.51*	-0.51*	0.31	-0.29	0.01	-0.30	0.74**	0.35	-0.37	-0.08	-0.31
X2	0.81**	—	-0.17	0.07	0.22	0.22	0.81**	-0.39	0.03	-0.67**	0.19	-0.28	0.16	-0.24	-0.02
X3	0.74**	0.29	—	-0.83**	-0.54*	-0.54*	-0.25	0.7**	0.67**	0.29	0.65**	0.47*	-0.94**	-0.61**	-0.92**
X4	-0.01	0.50*	0.07	—	0.74**	0.74**	0.46*	-0.54*	-0.55*	0.02	-0.93**	-0.84**	0.96**	0.35	0.81**
X5	-0.78**	-0.25	-0.96**	-0.01	—	1**	0.56*	0.01	0.11	-0.41	-0.77**	-0.83**	0.65**	-0.27	0.31
X6	-0.78**	-0.25	-0.96**	-0.01	0.99**	—	0.56*	0.01	0.11	-0.41	-0.77**	-0.83**	0.65**	-0.27	0.31
X7	-0.15	0.37	-0.76**	-0.02	0.81**	0.81**	—	-0.35	-0.01	-0.35	-0.31	-0.76**	0.42	-0.32	0.11
X8	0.03	-0.07	0.99**	-0.11	-0.33	-0.33	-0.61**	—	0.90**	0.01	0.24	0.24	-0.68**	-0.75**	-0.88**
X9	0.30	0.32	0.99**	-0.11	-0.26	-0.26	-0.29	0.99**	—	-0.32	0.36	0.14	-0.66**	-0.92**	-0.88**
X10	-0.44	-0.83**	-0.01	-0.04	-0.17	-0.17	-0.23	-0.08	-0.42	—	-0.17	0.03	-0.1	0.27	0.07
X11	0.49*	-0.01	0.25	-0.99**	-0.28	-0.28	-0.01	0.02	0.14	-0.10	—	0.83**	-0.82**	-0.19	-0.65**
X12	0.77**	0.30	0.99**	0.02	-0.99**	-0.99**	-0.99**	0.60**	0.52*	-0.10	0.26	—	-0.71**	0.16	-0.39
X13	-0.48*	0.05	-0.99**	0.71**	0.65**	0.65**	0.50*	-0.74**	-0.74**	-0.09	-0.67**	-0.73**	—	0.50*	0.90**
X14	-0.67**	-0.75**	-0.99**	-0.19	0.49*	0.49*	0.21	-0.99**	-0.99**	0.35	0.30	-0.87**	0.54*	—	0.81**
X15	-0.52*	-0.18	-0.99**	0.51*	0.48*	0.48*	0.27	-0.96**	-0.99**	0.19	-0.46*	-0.66**	0.97**	0.71**	—

* Significant at the 5% level ** Significant at the 1% level.

X1: the number of days up to 75% of tassel
X2: the number of days up to 75% of silk
X3: plant higher
X4: leaf area
X5: the percentage of nitrogen in the grain
X6: the percentage of protein in the grain
X7: the percentage of oil in the grain
X8: the number of branches of the tassel
X9: Total lengths of the tassel branches
X10: Pollen vitality
X11: the number of ears in a plant
X12: The number of grains per ear
X13: The 500 grain's weight
X14: yield efficiency
X15: grain yield

4.2 Stepwise Regression Analysis

Stepwise regression process was adapted with a semi-automated protocol that included the addition and removal of indepandent variables based on the t and f statistics of its estimated coefficients. Gradual regression was used to remove the effect of ineffective characteristics in the regression model on grain yield.

Grain yield was used as the dependent variable, and the other studied traits were used as predictive variables. A stepwise regression analysis was performed for the obtained data to test the importance of the independent variables and their impact on the grain yield (dependent).

It is clear from Table (2) that the analysis of variance was carried out in five stages, all of which were highly significant at the 1% level.

TABLE 2. Analysis of variance for regression analysis of sequential steps for the studied traits

ANOVA[a]

	Model	Sum of Squares	Df	Mean Square	F
1	Regression	47820809.884	1	47820809.884	94.378[b]**

	Residual	35468548.336	70	506693.548	
	Total	83289358.220	71		
	Regression	59005946.100	2	29502973.050	83.831[c]**
2	Residual	24283412.121	69	351933.509	
	Total	83289358.220	71		
	Regression	68705065.360	3	22901688.453	106.780[d]**
3	Residual	14584292.860	68	214474.895	
	Total	83289358.220	71		
	Regression	79415929.254	4	19853982.313	343.421[e]**
4	Residual	3873428.967	67	57812.373	
	Total	83289358.220	71		
	Regression	79413050.961	3	26471016.987	464.367[f]**
5	Residual	3876307.259	68	57004.519	
	Total	83289358.220	71		

** Significant at the 1% level.

a. Dependent Variable: VAR00015

b. Predictors: (Constant), VAR00013

c. Predictors: (Constant), VAR00013, VAR00012

d. Predictors: (Constant), VAR00013, VAR00012, VAR00014

e. Predictors: (Constant), VAR00013, VAR00012, VAR00014, VAR00004

f. Predictors: (Constant), VAR00013, VAR00014, VAR00004

Table (3) shows the results of the stepwise regression. whereas:

The first stage comprised the introduction of the trait the 500 grain's weight (X13) into the form, and the coefficient of determination for this stage was 0.57.The coefficient of determination increased in the second stage to 0.70 after adding the trait the number of grains per ear (X12) so that the model involved the traits weight 500 grain (X13) and the number of grains per ear (X12) together. In the third stage, the trait yield efficiency (X14) was added This led to an increase in the coefficient of determination of 0.82.Thus, the model contained the 500 grain's weight (X13), the number of grains per ear (X12), and yield efficiency (X14).

Then the trait leaf area (X4) was introduced in the fourth stage in addition to the previous traits, which increased the determination coefficient to become 0.95.

Concerning the fifth and final step, the trait the number of grains per ear (X12) was excluded and the traits weight 500 grain (X13), yield efficiency (X14) and leaf area (X4) were retained in the model because it did not affect the determination coefficient, as it remained at the same value of 0.95 with the reduction of the experimental error of estimation from 240.44 to 238.76.

The features that were entered into the prediction equation are the features that had the highest coefficient of determination and that were associated with the yiald. The prediction equation was formulated as follows:

$$\hat{Y} = -7048.23 + 7.82(X13) + 26.98(X14) + 1.20(X4);\ R^2 = 0.95$$

According to this equation, 95% of the total variance in grain yield can be linearly related to the variables accepted in the regression analysis.

Acceptable variables are the 500 grain's weight (X13), yield efficiency (X14) and leaf area (X4) as these traits were responsible for yield variance. In [18] agreed with this, who stated that serial regression analysis proved that leaf area and weight of 500 grains had the greatest effect on the total variance of maize yield in intercropping with cowpeas.

The results of [5] for stepwise regression analysis of maize revealed that the acceptable variables are the weight of 1000 grains, the number of grains per row, the number of rows per ear, and the harvest index were responsible for (82.2%, 2.9%, 2.3%, and 1.5%), respectively, of the total variance of yield.

These outcomes reinforce the results of genetic associations, since the trait weight of 500 grains is the most determinant of grain yield.

As for the rest of the variables, they were removed because they had no effect on the yield.

In the regression of the stepwise, the variable added at each step was the one that achieves the largest decrease in the experimental error of estimation. It is the variable that has the highest relative contribution to the coefficient of determination with the variable dependent on the fixed values of those previously added variables.

TABLE 3. Sequential step regression analysis equations

Step	Equations	R^2	Coff. Std. Error
1	$\hat{Y} = 2715.16 + 40.67(X13)$	0.57	711.82
2	$\hat{Y} = 115.57 + 37.82(X13) + 5.13(X12)$	0.70	593.24
3	$\hat{Y} = -2660.28 + 32.31(X13) + 5.57(X12) + 12.89(X14)$	0.82	463.11
4	$\hat{Y} = -7071.94 + 7.56(X13) - 0.12(X12) + 27.15(X14) + 1.21(X4)$	0.95	240.44
5	$\hat{Y} = -7048.32 + 7.82(X13) + 26.98(X14) + 1.20(X4)$	0.95	238.76

5. CONCLUSION

The ruslts have shown that the closest related treats to the yield were the 500 grain's weight, the yield efficiency and the leaf area. This was confirmed by the stipwise regression analysis. When the highest genetic correlation was achieved between the 500 grain's weight and the grain yield, this enables us to consider this trait as a selective criterion for improving grain yield.

6. REFERENCES

1. Ali, N., and Anjum, M.M. "Effect of Different Nitrogen Rates on Growth, Yield and Quality of Maize" *Middle East Journal of Agriculture Research*, Vol. 6, No. 1, 107–112, (2017).
2. Wang, J, and Hu, X. "Research on Corn Production Efficiency and Influencing Factors of Typical Farms: Based on Data from 12 Corn-Producing Countries from 2012 to 2019." *PLOS ONE*, Vol. 16, No. 7, 1-17, (2021).
3. Crosbi, T.M., and Mock,j.j. "Ganges in physiological traits associated with grain yield improvement in three maize breeding programs1".Crop Sci Vol 21, No 2 ,255-259,(1981).
4. Kalla,V., Kumar, R., and Basandrai, A.K., "Combining ability analysis and gene action estimates of yield and yield contributing characters in maize (Zea mays L.)", *Crop Res*, HISAR ,Vol. 22, No. 1, 102–106, (2001).
5. Ahmed, M.A.,Mehasen, S.,and Numanan, A."Multivariate of relating yield components in a set of corn genotypes"*Arab Universities Journal of Agricultural Science* ,Vol. 17, No.1,95-102,(2009).
6. Sreckov, Z., Nastastic, A., Bocanski, J., Djalovic, I., Vukosavljev, M., Jockovic, B., "Correlation and path analysis of grain yield and morphological traits in test-cross populations of maize", *Pakistan Journal of Botany*, Vol. 43, 1729-1731, (2011).
7. Pirzadeh, Moghaddam, M., Bagheri, A., Malekzadeh-Shafaroudi, S., Ganjeali, A., "Multivariate statistical analysis in chickpea (Cicer arietinum L.) under limited irrigation", *Iran J Pulses Res, Vol. 5, No. 2, 99–110, (2014)*..
8. Al-Abedy, J. A., Guide to the Use of Chemical and Organic Fertilizers in Iraq General Authority for Agricultural Extension and Cooperation, Republic of Iraq, (2011).
9. Robinson, H. F., Constock, R. E., and P. H., Harvey, "Genotypic and phenotypic correlation in corn and their implication to selection", *Agron J*, Vol. 43, 282-287, (1951).
10. Singh, R. K., and Chaudhary, B. D., "Biometrical Methods in Quantitative Genetic Analysis", *Reved Kalyani Publishers Ludhiana India*, P.P. 318, (1985).
11. Ghani, I. M., and Ahmed, S., "Stepwise Multiple Regression Method to Forecast Fish Landing", *International Conference on Mathematics Education Research, Procedia-Social and Behavioral Sciences*, Vol. 8, 549–554, (2010).
12. Damtie, Y., Assefa, G., Mulualem, T., "Genetic Variability Heritability Trait Associations and Path Coefficient Analysis of Maize (Zea mays L.) Inbreed Lines at Pawe Northwestren Ethiopia", *Pelagia Research Library*, Vol. 11, No. 2, 57-64, (2021).
13. Neto, R. A., Nass, L. L. de Miranda Filho, B. J., "Potential of twenty exotic germplasms to improve Brazilian maize architecture", *Brazilien Journal of Genetics*", Vol. 20, No. 4, (1997), DOI: 10.1590/S0100-84554997000400022
14. Rahim, F., Khan, M. Q., Ashraf, N., Shafi, N., Khawaja, S., Khalid, S., Zahid, G., Ahmed, M., Ahmed, M. S., "Characterization of Zea mays L. through morphological biochemical and molecular markers", *Applied Ecology and Environmental Research*, Vol. 17, No. 3, 6445-6456, (2019).
15. Wuhaib, K. M., "Evaluation of Maize Genotypes Responses to Different Levels of Nitrogen Fertilizer and Plant Populations and Path Coefficient Analysis", *PhD's Thesis, College of Agriculture, University of Baghdad*, P.P. 73, (2001).
16. Amegbor I. K., Biljon, A., Shargie, N., Tarekegne, A., and Labuschagne, M. T., "Heritability and Associations among Grain Yield and Quality Traits in Quality Protein Maize (QPM) and Non-QPM Hybrids", *Plants* (*Basel*), Vol. 11, 713, 1-17, (2022).
17. Kumar, A., Kumari, J., Rana, J. C., Chaudhary, D. P., Kumar, R., Singh, H., Singh, T. P., Dutta, M., "Diversity among maize landraces in North West Himalayan region of India assessed by agro-morphological and quality traits", *Indian J. Gen*., Vol.75, 188–195, (2015). DOI: 10.5958/0975-6906.2015.00029.2.
18. Fard, F. F., Mirshekari, B., Amirnia, R., "Multiple regression analysis for studied traits in intercropping of popcorn and cowpea", *International Journal of Biosciences*, Vol. 4, No. 4, 116-120, (2014).

Arabic Abstract

نفذت التجربة الحقلية في حقل التجارب التابع الى اعدادية ابن البيطار المهنية في قضاء الحسينية – محافظة كربلاء المقدسة خلال موسم الربيعي 2021، بهدف تحديد الصفات الأكثر ارتباطاً بمحصول الحبوب وتحديد المعادلة التنبؤية لستة تراكيب وراثية من الذرة الصفراء (5018، بحوث 106، المها، فجر1، الفرات وساره) وتقدير بعض المعالم الوراثية بتأثير اربعة مستويات من التسميد (160 N كغم.هـ-1، 160 N كغم.هـ-1 مع حامض الهيومك، 320 N كغم .هـ-1، 320 N كغم.هـ-1 مع حامض الهيومك) باستخدام ترتيب الالواح المنشقة وفق تصميم القطاعات الكاملة المعشاة RCBD بثلاثة مكررات، حيث تمثل التراكيب الوراثية للذرة الصفراء الألواح الثانوية والتسميد يمثل الالواح الرئيسية.

تم دراسة عدة صفات نمو ونوعية وصفات الحاصل وبعض مكوناته بالإضافة الى دراسة بعض صفات النورة الذكرية وحيوية حبوب اللقاح. تم دراسة الارتباطات الوراثية والمظهرية و تم ايجاد معادلة تنبؤ بالحاصل من خلال اجراء تحليل الانحدار المتسلسل (التدريجي).

تبين من تحليل الارتباطات المظهرية والوراثية ان قيم الارتباطات الوراثية اعلى من قيم الارتباطات المظهرية لأغلب الصفات. ارتبط حاصل الحبوب ارتباطا مظهرياً موجباً عالي المعنوية مع صفات المساحة الورقية ووزن 500 حبة وكفاءة الحاصل، وارتبطت ارتباطا وراثيا موجبا عالي المعنوية مع وزن 500 حبة (0.97) وكفاءة الحاصل (0.71). اتضح من تحليل الانحدار المتسلسل ان الصفات المستقلة التي ترتبط ارتباطاً وثيقاً مع المتغير التابع (الحاصل) كانت وحسب المعادلة التنبؤية للعائد هي وزن 500 حبة وكفاءة الحاصل والمساحة الورقية حيث كانت هذه الصفات مسؤولة عن 95% تباين الغلة.

نستنتج مما سبق امكانية استخدام 500 حبة معيارا انتخابيا لتحقيقه اعلى ارتباط وراثي مع حاصل الحبوب وقد اكد تحليل انحدار الخطوات المتسلسلة ذلك.

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N_2 Schiff Ligand with Mercury (II) Complex: Preparation and Characterization

Salwa Jassim Haji[1*], Shatha Abd-alameer Jawad[2]

[1*,2]*Chemistry Department, College of Education for Pure Science, University of Kerbala, Kerbala, Iraq*

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The Bi dentate ligand type N_2 molecule have been prepared through one step reaction between one equivalent of acetyl acetone with two equivalent of 4-phenoxy aniline, using ethanol as a solvent. This ligand was used to manufacture the target Hg (II) complex from action of the ligand and Mercury with a 1:1 ratio.The ligand and complex were characterized by infrared spectroscopy, the ultraviolet spectrum, the precise analysis of the elements (C.H.N.). ^{1}H-NMR spectrum and the mass spectrum of the new ligand were taken. The prepared complex was also diagnosed with molar conductivity and magnetic susceptibility. Suggested geometry around the Mercury ion is Tetrahedral.

1. INTRODUCTION

Chemical compounds containing the imine group are known as Schiff bases.They consist of a carbon atom double-bonded to a nitrogen atom (C=N)[1] .Alphabetic or aromatic primary amines, certain amino acids, and aldehydes combine to form aliphatic or aromatic ketones (carbonyl compounds) [2]. Colored crystals, which are often yellow in color, are typical in Schiff bases. Carbony l compounds and the type of amines - aliphatic or aromatic have a major influence on the characteristics and stability of Schiff bases .The used aldehyde, ketone, or amine also affects the stability of these types of compounds[3]. The most stable bases are Schiff bases prepared from an aromatic aldehyde and an aromatic amine. This is due to the increased stability by resonance. The availability, electronic features, and simplicity of Schiff base ligands have all led to great deal of investigations. Recent years have seen a tremendous increase in interest in Schiff base coordination chemistry because of its important applications in analytical chemistry[4], organic synthesis, electroplating, metal refining, metallurgy, and photography[5]. Both the advancement of bioinorganic chemistry and contemporary coordination chemistry depend strongly on schiff bases[6].They have several usages in medicine because of their pharmacological characteristics. The biological activity of azomethine derivatives[7] depends on the (C=N). A number of azomethines were therefore found to have diuretic, anticancer, and antimicrobial (antibacterial, antifungal) properties[8]. Schiff bases are widely used in agrochemicals, analytical chemistry[9], food and dye industrie, catalysis[10], and fungicidal characteristics. There have been numerous reports on applications over the past few decades, particularly in biology. Among these reports are the ones that have antiviral, antifungal[11], antioxidant, anticancer, anti-inflammatory, and antimalarial properties[12]. Thus,it necessary to do a review that emphasizes the uses of Schiff base ligands and their complexes.

2. APPARATUS

Melting point, /SMP30/ , Strut, England, HOT plate with magnetic stirrer MR Hei - standard ,Heldolph ,Germany, Balance BL 2105, Sartorius, Germany, Oven BS size two, Gallenkamp, England, UV-Visible spectra recorded by UV-Visible spectrophotometer (Shimadzu- UV-1700), FT-IR Test scan Shimadzu model 8000, the IR spectra of the compound (400-4000 cm-1), ^{1}H-NMR spectra by using Varian-Ultra Shield 500 MHz (Switzerland) with DMSO-d^6 solvent, as well as Auto Magnetic susceptibility Balance Sherwood Scientific the electrical conductivity was measured using a digital conductivity meter WT-720-inolab (Germany), and mass spectra Work mass selective Detector 5973 and using an energy of 70 Electron Volt.

*Corresponding Author Institutional Email: salwa.j@s.uokerbala.edu.iq (Salwa Jassim Haji)

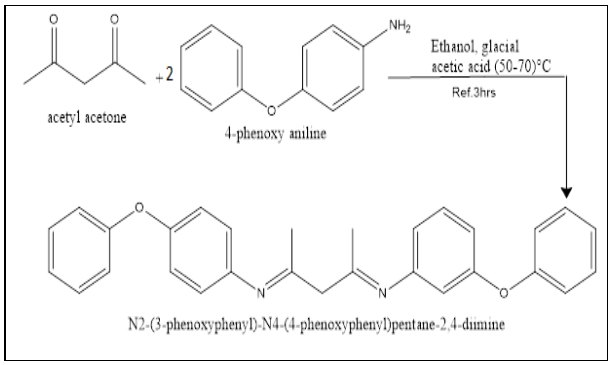
3. EXPERMINTAL

3.1 Materials

There is sufficient purification for every chemical that is utilized from Merek, Aldrich, and Fluka.

3.1.1 Synthesis of new ligand(2E,4E)

(0.001mol,1.0216 mL) of acetyl acetone dissolved in 10 ml of pure ethanol) was placed with the addition of three drops of glacial acetic acid,(solution. 1). Next, we took (0.1852 mol 0.001 g) of 4-phenoxy aniline that was well dissolved in 20 ml of absolute ethanol,(Solution .2), in a sublimation device. Place (Solution.1) and gradually add (Solution .2) to it.Then, we begin the reverse sublimation process (Reflux) for 3h at a temperature of (50 -60) °C with the circular-bottomed reaction flask with a capacity of (100 mL) placed submerged in a water bath. After the reaction, the mixture is left to dry in the air for 24h. at room temperature before it is being washed and recrystallized using diethyl ether. It forms a yellowish-brown precipitate, yelled %70 as in (Scheme1)



Scheme 1. Reagent preparation step

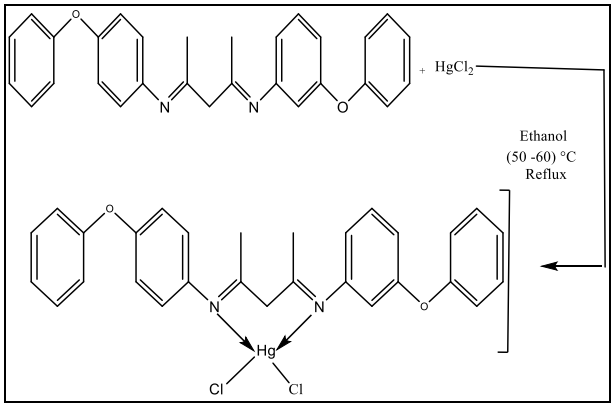
Elemental Analysis: C, 80.16(79.16); H, 6.03(5.03); N, 6.45(5.25); O, 7.36(6.16), the chemical composition of the ligand as well as certain physical characteristics are presented in Table (1).

TABLE 1. Explains the physical properties and chemical formula of the ligand**.**

Color	Proportion of roduct	M.P (C°)	M.wt	Chemical Formula	Name and symbol
yellowish-brown	yelled:70.0 %	280-283	434.5	$C_{29}H_{26}N_2O_2$	(2E,4E)-N2-(3-phenoxyphenyl)-N4-(4-phenoxyphenyl)pentane-2,4-diimine

3.1.2 . Preparation of the Hg(II) complex

reflex and stirring with(0.11g),of $HgCl_2$ for 3h at(50–60)°C, with a mixture containing (0.2g) of ligand dissolves in (25 mL) of absolute Ethanol. The brown precipitate form, is filtered out, and is allowed to air dry. MP:277-280°C; yelled:70.0%; Chemical Formula: $C_{29}H_{26}Cl_2HgN_2O_2$ 4; M.wt: 706.0 Elemental Analysis: Elemental Analysis: C, 49.33(48.83); H, 3.71(2.71); Hg, 28.41(27.41); N, 3.97(2.47); O, 4.53(3.53) as in **(Scheme2)**.



Scheme 2. Preparation of Mercury complex

4. PRODUCT DESCRIPTION

Ultraviolet-visible (UV-Vis), infrared (FT-IR), and the precise analysis of the elements (C.H.N.), melting point analysis were used to characterize the produced ligand and complex. while the ^{1}H-NMR spectrum and the mass spectrum of the new ligand were taken. Aside from that, the generated complex was assessed by using molar conductivity and magnetic successptibility.

5- RESULTS AND DISCUSSION

5.1 UV-Visible spectra for ligand

The electronic absorption spectra of the Schiff base ligand were obtained at room temperature in an absolute ethanol solution (1×10^{-3}) mole [13]. It is seen in **(Figure 1)**. There are two electron transitions in the ultra violet region of the ligand's UV-Vis electronic transition.: the $\pi \longrightarrow \pi^*$ transition which occurs at (λ = 240nm) with absorbance 0.669 while the $n \longrightarrow \pi^*$ transition occurs at(λ = 334nm)with absorbance 0.233.

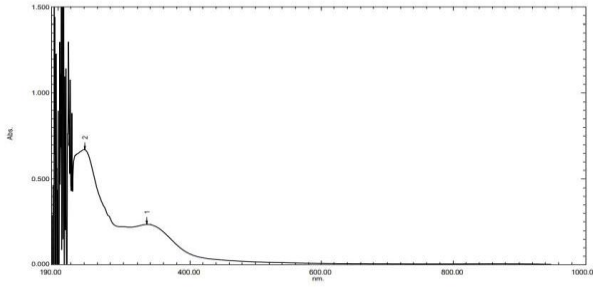


Figure 1. The UV-Vis spectrum of ligand

5.2 UV- Visible spectra for Mercury complex

The Schiff base complex's electronic absorption spectra were obtained in an absolute ethanol solution 10^{-3}mole at room temperature[14]. Just as (Figure 2) shows, the compound undergoes electronic transitions at wavelengths of (λ = 244nm), where the absorbance is 0.448, and (λ =221nm), when the absorbance is 0.472. C.T. is characterized by charge transfers ,There are no d-d transitions in the visible spectrum because Mercury is of the d^{10} type, which indicates that the d orbital is filled with electrons.

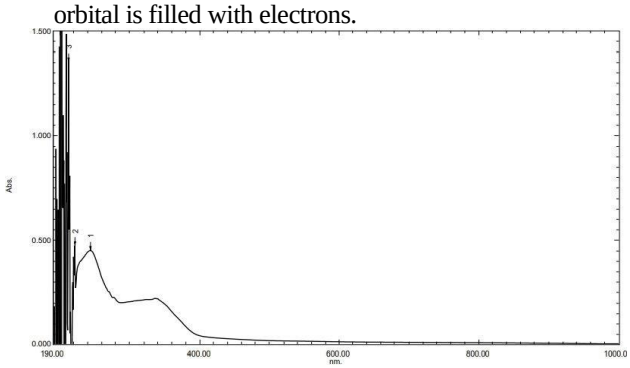


Figure 2. UV-Visb for Mercury complex

5.3 FT-IR spectra

As exposed in figure (3), we can distinguish the ligand's (L) IR spectra[15] by the appearance of some bands with distinct frequencies such as υ (-CH) at (3167) cm^{1-} belonging to the aromatic rings and υ ($-CH_2$) at (2980) cm, υ ($-CH_3$) at (2889) cm^{1-}. A distinct band also appeared at (1633) cm^{1-} originating from the azomethine group υ (C=N) frequency, finally, at (1394) cm^{1-} represents the frequency of the ether group (C-O-C).

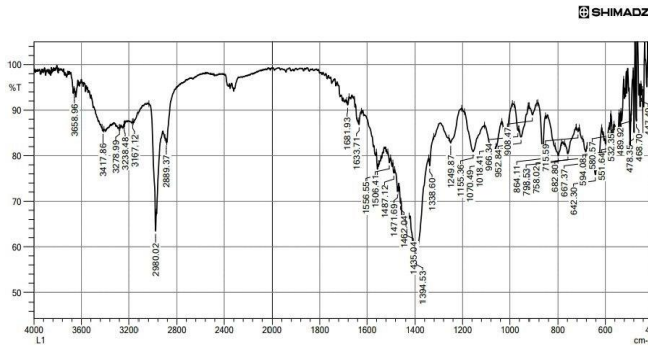


Figure 3. Schiff base ligand spectrum in FT-IR

When comparing the ligand's spectrum to the Mercury complex (HgL) spectrum displayed in Figure (4), it was found that different shifts occurred for the same groups mentioned above, with the appearance of new frequencies for other groups, such as the frequency of υ (M-N) at (422-470)cm^{1-}, suggesting that there is coordination in the aforementioned complex[16].

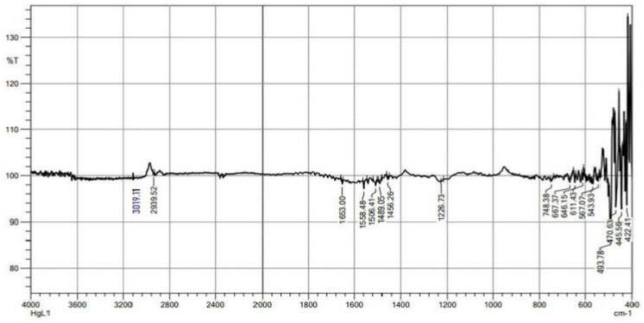


Figure 4. FT-IR spectrum of the Mercury complex

5.4. Proton NMR spectrum for ligand

The 1H-NMR spectra of the Schiff base ligand obtained by using the solvent DMSO-d^6, reveals the synthesis process as described in **Figure (5).** With its chemical shift displayed at (δ = 2.522 ppm), a signal for two groups (-CH3) in the range (δ=1.1-1.3 ppm,6H) , another signal for the group (CH2) at the chemical shift (δ = 3.4ppm,2H) and further signal in the range (δ = 6.9-8.9ppm,18H) refer to aromatic rings in which C-H groups form in different environments[17].

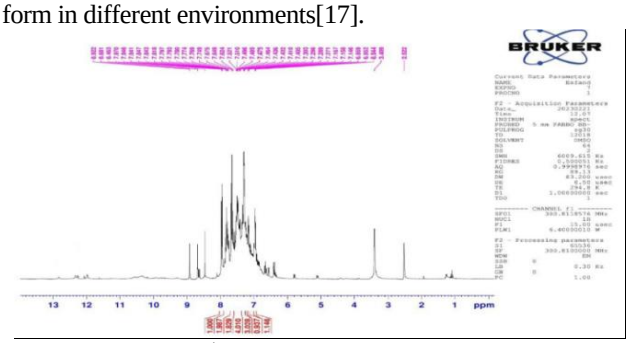


Figure 5. ^{1}H-NMR spectra of The ligand

5.5. Mass spectrum of the ligand

Figure (6) offers free ligand (L) mass spectrum displayed the charge to-mass ratio M/Z^+(M.wt=434), which is proportional to the molecular weight of the compound[18].

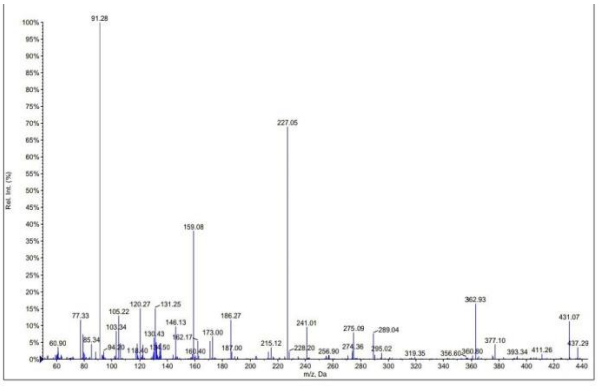
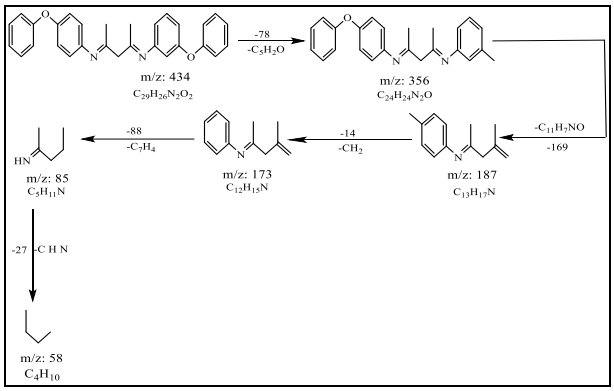


Figure 6. Mass spectrum of the ligand

The Scheme (3) shows the partitioning method for the mass spectrum of the compound



Scheme 3. Ligand fragmentation

5.6. Magnetic susceptibility and molar conductivity of Mercury complex

Mercury's complex is classified as dia-magnetic because it possesses the d^{10} system, which, in a hybridized state, has no single electron[19]. The complex's molar conductivity was measured at room temperature (25°C) using DMSO as the solvent. The complex's concentration was 0.001 M, and the resultant value of 18.6 $S.mol^{-1}. cm^2$ demonstrated the complex's non-electrolytic character[19], which supports its tetrahedral geometry.

6. CONCLUSION

The Bi dentate ligand typeN_2 was prepared in one step by reacting one equivalent of acetylacetone with two equivalent of 4-phenoxyaniline using ethanol as a solvent.This research includes the preparation of a Schiff base ligand and a Mercury complex. The prepared ligand and complex were characterized by infrared spectroscopy,The ultraviolet spectrum, the precise analysis of the elements (C.H.N.). ^{1}H-NMR spectrum and the mass spectrum of the new ligand were taken .The prepared complex was also diagnosed with magnetic susceptibility.This confirmed the proposed tetrahedral shape of the Mercury ion, in addition to the molar conductivity, which revealed that the complex is non electrolytic.

7. REFERENCES

1. E. Raczuk, B. Dmochowska, J. Samaszko-Fiertek, and J. Madaj, "Different Schiff bases—structure, importance and classification," Molecules, vol. 27, no. 3, p. 787, 2022.
2. L. Fabbrizzi, "Beauty in chemistry: making artistic molecules with Schiff bases," The Journal of Organic Chemistry, vol. 85, no. 19, pp. 12212-12226, 2020.
3. Y. Wang et al., "Evaluation of schiff-base covalent organic frameworks for CO2 capture: structure–performance relationships, stability, and performance under wet conditions," ACS Sustainable Chemistry & Engineering, vol. 10, no. 1, pp. 332-341, 2021.
4. A. Hassan and A. Said, "Importance of the Applicability of O-Vanillin Schiff Base Complexes," Adv. J. Chem., Sect. A, vol. 4, pp. 87-103, 2020.
5. J. L. Segura, M. J. Mancheño, and F. Zamora, "Covalent organic frameworks based on Schiff-base chemistry: synthesis, properties and potential applications," Chemical Society Reviews, vol. 45, no. 20, pp. 5635-5671, 2016.
6. M. Andruh, "The exceptionally rich coordination chemistry generated by Schiff-base ligands derived from o-vanillin," Dalton Transactions, vol. 44, no. 38, pp. 16633-16653, 2015.
7. A. Hameed, M. Al-Rashida, M. Uroos, S. Abid Ali, and K. M. Khan, "Schiff bases in medicinal chemistry: a patent review (2010-2015)," Expert opinion on therapeutic patents, vol. 27, no. 1, pp. 63-79, 2017.
8. G. Matela, "Schiff bases and complexes: a review on anti-cancer activity," Anti-Cancer Agents in Medicinal Chemistry (Formerly Current Medicinal Chemistry-Anti-Cancer Agents), vol. 20, no. 16, pp. 1908-1917, 2020.
9. X. Li, D. Zhang, Z. Liu, Y. Xu, and D. Wang, "Synthesis, characterization of a ternary Cu (II) Schiff base complex with degradation activity of organophosphorus pesticides," Inorganica Chimica Acta, vol. 471, pp. 280-289, 2018.
10. S. A. Dalia et al., "A short review on chemistry of schiff base metal complexes and their catalytic application," Int. J. Chem. Stud, vol. 6, no. 3, pp. 2859-2867, 2018.
11. R. S. Joseyphus and M. S. Nair, "Antibacterial and antifungal studies on some schiff base complexes of zinc (II)," Mycobiology, vol. 36, no. 2, pp. 93-98, 2008.
12. M. Sharma et al., "Design and synthesis of a new class of 4-aminoquinolinyl-and 9-anilinoacridinyl Schiff base hydrazones as potent antimalarial agents," Chemical biology & drug design, vol. 84, no. 2, pp. 175-181, 2014.
13. E. Quagraine and R. Reid, "UV/visible spectrophotometric studies of the interactions of thiomolybdates, copper (II) and other ligands," Journal of inorganic biochemistry, vol. 85, no. 1, pp. 53-60, 2001.
14. H. Deng and G. J. Van Berkel, "Electrospray mass spectrometry and UV/visible spectrophotometry studies of aluminum (III)–flavonoid complexes," Journal of mass spectrometry, vol. 33, no. 11, pp. 1080-1087, 1998.
15. O. Faix, "Classification of lignins from different botanical origins by FT-IR spectroscopy," 1991.
16. V. Alverdi et al., "Characterization studies and cytotoxicity assays of Pt (II) and Pd (II) dithiocarbamate complexes by means of FT-IR, NMR spectroscopy and mass spectrometry," Journal of Inorganic Biochemistry, vol. 98, no. 6, pp. 1117-1128, 2004.
17. B. Meyer and T. Peters, "NMR spectroscopy techniques for screening and identifying ligand binding to protein receptors," Angewandte Chemie International Edition, vol. 42, no. 8, pp. 864-890, 2003.
18. V. B. Di Marco and G. G. Bombi, "Electrospray mass spectrometry (ESI-MS) in the study of metal–ligand solution equilibria," Mass Spectrometry Reviews, vol. 25, no. 3, pp. 347-379, 2006.
19. D. Nelson and L. W. Ter Haar, "Single-crystal studies of the zero-field splitting and magnetic exchange interactions in the magnetic susceptibility calibrant mercury cobalt-thiocyanate (HgCo (NCS) 4)," Inorganic chemistry, vol. 32, no. 2, pp. 182-188, 1993.

Arabic Abstract

تم تحضير الليكاند ثنائي السن من النوع N_2 من خلال خطوة واحدة تضمنت التفاعل بين مكافئ واحد من الأسيتيل أسيتون مع مكافئين من 4-فينوكسي أنيلين، باستخدام الإيثانول كمذيب. يستخدم الليكاند بعد ذلك لتحضير معقد Hg (II) بنسبة مولية 1:1، وشخص الليكند والمعقد المقترح بواسطة التحليل الطيفي للأشعة تحت الحمراء، وطيف الاشعة فوق البنفسجية، والتحليل الدقيق ،و طيف ^{1}H-NMR والطيف الكتلي لليكند الجديد، كما تم تشخيص المعقد المحضر من خلال التوصيلية المولارية والحساسية المغناطيسية . وكان الشكل الهندسي المقترح لأيون الزئبق هو رباعي السطوح.

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The Relation between Diabetes Mellitus Type Two and Osteioarthritis in Iraqi Women

Soaad abdullah akaash[1]* , Rehab Jasim Mohammed[2] , Atheer Hameid Odda[3]

[1,2] Department of Chemistry, College of Education for Pure Sciences, University of Kerbala
[3] Department of Bio Chemistry, College of Medicin, University of Kerbala

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Diabetes smellitus, Osteoarthritis, Fasting blood sugar, Hemoglobin A1C

A B S T R A C T

Diabetes mellitus type two and osteoarthritis are the most common diseases in Iraq in particular and in the world in general. There are many factors that lead to infection with these two diseases, which are considered the problem of the times. The obesity and aging are the main causes of these two diseases in addition to many other causes such as a wrong lifestyle, lack of exercise, etc. Some tests related to the two diseases were measured to determine the extent of the relationship between them, as fasting blood sugar and hemoglobin A1C for diabetes mellitus. Concerning osteoarthritis, serum calcium, vitamin D3, parathyroid hormone, high sensitivity C-reactive protein, serum albumin and alkaline phosphatase had been measured. The present work was carried out at Diabetic type two and osteoarthritis patients in orthopedic clinic in AL-IMAM Al- Hassan Hospital in holy Karbala city (50 women aged 40-70 years) and 40 women apparently healthy as a control group. The results showed that there is a significant difference between patients group and controls group in alkaline phosphatase, parathyroid hormone and high sensitivity C-reactive protein ($p<0.05$). There are noteworthy differences in Alb and calcium ($p<0.01$), Alb and negatively important with PTH ($P<0.05$). Significant differences in high sensitivity C-reactive protein and phosphorus($P<0.05$).

1. INTRODUCTION

Osteoarthritis (OA) and diabetes mellitus (DM) afflict approximately 1 billion individuals globally [1], Type 2 diabetes mellitus (T2DM) is characterized by hyperglycemia and abnormal insulin secretion. Osteoarthritis (OA) is a prevalent degenerative joint disease in clinical practice, presenting with joint pain, limited function and a certain disability rate. It has been observed that there exists a substantial correlation between T2DM and OA, with the incidence of OA being notably higher in the T2DM group compared with the non-T2DM group. [2]
14.3 million individuals in the 45–64 age range, and 12.0 million individuals over the age of 65. In a similar vein, 14% of adults over 25 and 37% of adults over 60 have radiographically diagnosed knee OA.[3] T2DM is a prevalent and intricate ailment that has both hereditary and environmental risk factors, such as unhealthy lifestyle choices that lead to obesity and overweight. The incidence of the condition increases dramatically with age. Among people over 65, T2DM affects nearly 10% of the population [4]
Diabetes type I T2DM is a prevalent, complex condition that has a genetic cause. Type 2 diabetes (T2DM) is a prevalent and intricate ailment that has both hereditary and environmental risk factors, such as unhealthy lifestyle selections that lead to obesity and overweight. The incidence of the condition increases dramatically with age, with over 10% of people over 65 suffering from type 2 diabetes. [5] The condition is caused by a deficiency in insulin production by pancreatic beta-cells, as well as cellular insulin resistance, which is seen mostly in skeletal muscles and the liver, but sometimes in other tissues [6]. Prolonged hyperglycemia, both fasting and postprandial, causes oxidative stress, and low-grade inflammation, as well as damage to the arteries, mostly in the heart, kidneys, eyes, and nerves and in other tissues. [7]
Osteoarthritis normally progresses slowly. It influences all of the joint's components, including the synovium, ligaments, articular cartilage, and subchondral bone. The synovial joints sustain damage from mechanical, inflammatory, and metabolic causes during the course of osteoarthritis [8]. Degenerative alterations in the articular cartilage are a defining characteristic of

*Corresponding Author Institutional Email:
soaad.akaashs@s.uokerbala.edu.iq (Soaad abdullah akaash)

osteoarthritis. During the early stages of the disease, the amount of water in the cartilage increases and the number of proteoglycans decreases. Furthermore, there is a decrease in the formation of newly deposited collagen type 2 and an increase in its breakdown, which weakens the collagen network. The amplification of cartilage apoptosis is also connected with a decrease in the population of functionally active chondrocytes. [9] The aforementioned modifications result in a decrease in the cartilage's elasticity and compressive strength. Deeper layers of articular cartilage include chondrocytes that proliferate in response to degenerative processes, producing new collagen and proteoglycans that start the healing process [10].

2. PATIENTS AND METHODS

This study was carried out at Diabetic type two and osteoarthritis patients in Clinic of orthopedic specialist in AL-IMAM Al- Hassan Hospital in holy Kerbala city (50 women aged 40-70 years) and 40 women apparently healthy as a control group to find the relation between certain variables including (age, hemoglobin A1c (HbA1c), blood glucose, alkaline phosphatase (ALP), albumin (Alb), calcium(Ca), parathyroid hormone (PTH), high sensitive c-reactive protein HsCRP, BMI and vitamin D3 in serum.

During period of data collection, patients were interviewed by questionnaire from those visited the joint consultation clinic. the questionnaire included number, age, weight, length, duration of diabetes, treatment of diabetes, treatment of osteoarthritis, other diseases and other treatments. An immunoassay method was used for quantification of HbA1C, vitamin D3, HsCRP and PTH while ALP, FBS, Alb and phosphorus are quantified by colorimetric method.

3. THE RESULTS AND DISCUSSION

This study covered (50 women) who suffer from diabetes mellitus type two and osteoarthritis diseases as patients group and (40 women) apparently healthy as control
group aged (40-70) years. The dependent variable for this study was the type of group while the independent variables of this study were including (age, BMI, HbA1c, blood glucose, ALP, Alb, Ca, PTH, HsCRP, phosphorus, and vitamin D3). Statistical analysis was carried out using SPSS version 26. Analysis of variance (T test) was utilized to compare means between two groups.

TABLE 1. Descriptive table

Subject	Type of group	No	Mean ±SD	Range	P-value
Age	Control	40	50.8750±8.60586	70-40	p>0.05
	Patient	50	53.3600±8.02740	70-40	
BMI	Control	40	26.8197 ±3.37477	33.320.8	p>0.05
	Patient	50	29.7014±5.90892	46.676.8	

This study has revealed that there are no noteworthy differences between control group and patient group in age and BMI as stated in table (1)

TABLE 2. Serum level of HbA1C and glucose in patients with diabetes and osteoarthritis diseases .

Subject	Type of group	No	Mean ±SD	Range	cP-value
	Control	40	5.0875±0.69363	3-6	P<0.05
HbA1C	Patient	50	9.78±1.99786	13-6.5	
Glu	Control	40	101.5250±12.84022	122-70	P<0.05
	Patient	50	212.16±78.78293	488-129	

Table (2) showed that there is a significant difference ($p<0.05$) between patient group and control group in HbA1C and glucose. Chronic hyperglycemia is a hallmark of diabetes, which can lead to long-term problems. [11] The levels of HbA1c and FBS are highly linked because glycated hemoglobin is a measure of integrated glycaemia over the course of a red blood cell's 120-day life. [12] HbA1c is a useful tool for long-term diabetes care and monitoring since it is a trustworthy indicator of chronic glycaemia and has a strong correlation with the risk of developing the disease. [13,14]

TABLE 3. Serum level of phosphorus, alkaline phosphatase, albumin, calcium, PTH, HsCRP and D3 in patients with diabetes mellitus type two and osteoarthritis diseases

Subject	Type of group	No	Mean ±SD	Range	P-value
Pi	Control	40	3.2905±o.62352	4.5-2	p>0.05
	Patient	50	3.6016±0.667793	6.24-2.66	
ALP	Control	40	535.65±524.03893	2755-20	P<0.05
	Patient	50	1088.18±131270355	5662-41	
Alb	Control	40	3.9373±0.37254	4.7-2.99	p>0.05
	Patient	50	3.8860±0.41355	4.5-2.4	
Ca	Control	40	8.3375±0.93745	11-6.5	p>0.05
	Patient	50	8.368±0.9711	11.1-5.8	
PTH	Control	40	33.625±14.68269	72.1-11	P<0.05
	Patient	50	28.7278±12.78352	56.9-10	
HsCRP	Control	40	3.3330±2.25606	13-0.61	P<0.05
	Patient	50	13.717±16.51294	62.41-0.5	
D3	Control	40	12.5915±4.58294	25.21-6.27	p>0.05
	Patient	50	15.05±7.10373	62.41-7.11	

There is a significant difference between patient group and control group in ALP, ($p<0.05$) The level of the hepatic alkaline phosphatase increases significantly in diabetics. Number of studies have revealed that ALP is correlated with glucose metabolism, insulin resistance, and metabolic syndrome due to its role as a hepatobiliary marker [15]. There is a significant difference between patient group and control group in PTH ($p<0.05$)

type 2 diabetes causes decreased bone turnover and decreased bone resorption, which is linked to a decrease in the level of parathyroid hormone [16,17]. There is an important dissimilarity between patient group and control group in HsCRP ($p<0.05$) Previous studies have shown that BMI, comorbidities (diabetes mellitus, osteoarthritis severity, muscle strength changes, and female endocrine instability, atherosclerosis, obesity the patients increase the HsCRP level [18].

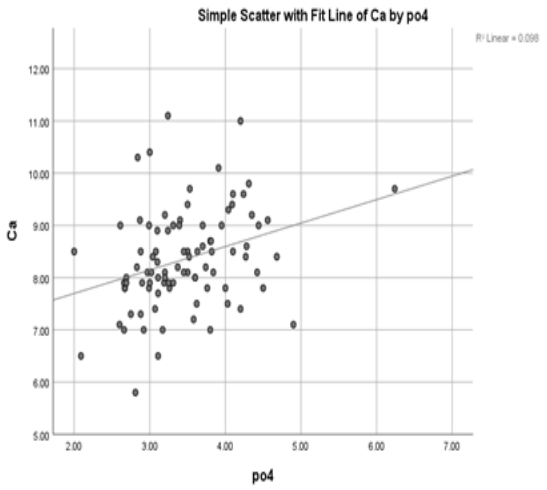

Figure 1. Correlation between calcium and phosphorus

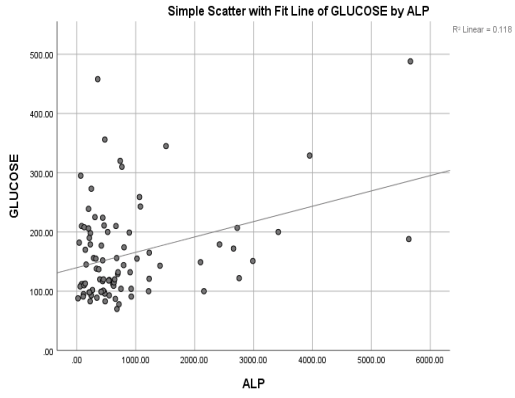

Figure 2. Correlation between Glucose and ALP

4. CONCLUSIONS

Type 2 diabetes has been found to indirectly affect the bones and joints, i.e. osteoarthritis, in women after the age of forty. Through this study, it is found that there are many components that change due to diabetes, and their variation is evidence of the presence of arthritis in the same patient.

1- increase ALP in diabetes patients which is also noticed in arthritis patients bon diseases.

2-It has been observed that the level of parathyroid hormone decreases in patients, and this does not agree with many studies that confirm the increase of this hormone in diabetics.

3-Results show that Albumin is negatively significant with PTH and significant differences exist in HsCRP and phosphorus.

5. REFERENCES

1. Priyanka Tanwar, Mamta Naagar, and Manish Kumar Maity, “Relationship between Type 2 Diabetes Mellitus and Osteoarthritis,” International Research Journal of Pharmacy and Medical Sciences (IRJPMS), Volume 6, Issue 2, pp. 59-70, 2023.
2. Perveen S. ital. A hybrid approach for modeling type 2 diabetes mellitus progression. Front Genet10: 1076 (2019).
3. Benjamin Abramoff Franklin E Caldera. Osteoarthritis: Pathology, Diagnosis, and Treatment Options. Epub (2019).
4. Sun, P.et al. diabetes Atlas: global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045 Diabetes Res. Clin. Pract., 183 (2021), article 109119, 10.1016/j.diabres..109119 Google ScholarL. =-=-=(2021)
5. Ismail, H. Materwala, J. Al Kaabi, Association of risk factors with type 2 diabetes: a systematic review Comput. Struct. Biotechnol. J., 19 pp. 1759-1785(2021)
6. Zhang et al. “Fasting blood glucose levels in patients with different types of diseases” Progress in molecular biology and translational science (2019).
7. Shih et al.Cheng-Chung “Recent targets of osteoarthritis research” Best Practice & Research Clinical Rheumatology (2023)
8. Kamps, et al. Comorbidity in incident osteoarthritis cases and matched controls using electronic health record data, Arthritis Research and Therapy (2023).
9. Rios Arce, et al. Interactions between diabetes mellitus and osteoarthritis: from animal studies to clinical data Journal of Bone and Mineral Research Plus (2022) .
10. Cui A, et al. Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population based Studies. E Clinical Medicine)29 30:100587(2020). Google Scholar World Cat
11. Ram, ital. Variation in the relationship between fasting glucose and HbA1c: implications for the diagnosis of diabetes in different age and ethnic groups BMJ Open Diabetes Research and Care (2024).
12. Klonoff,David,C,Hemoglobinopathies and hmoglobin A1c in diabetes mellitus SAGE Publications Sage CA: Los Angeles, CA (2020).
13. David C.ital. Hemoglobinopathies and Hemoglobin A1c in Diabetes Mellitus First published online March 22, (2019)
14. Brown, et al. C-Reactive Protein Levels Correlate with Measures of Dysglycemia and Gut Microbiome Profiles Current Microbiology (2024).

15. Janina Vavanikunnel.et al. . Bone Turnover in type 2 Diabetes-the Role of PTH Volume 111, pages 587–596, (2022)

16. Masahiro Yamamoto,et al. Decreased PTH Levels Accompanied by Low Bone Formation Are Associated with Vertebral Fractures in Postmenopausal Women with Type 2 Diabetes Clin Endocrinol Metab 97: 1277–1284, (2012)
17. Li Cao, et al. Preoperative idiopathic CRP and ESR elevation increase the risk of PJI within 90-day after primary total knee arthroplasty in patients with osteoarthritis posted 09 Mar, (2022)
18. Brichacek A L, Brown CM. Alkaline phosphatase: a potential biomarker for stroke and implications for treatment. Metab Brain Dis. Feb;34(1):3-19. (2019)

Arabic Abstract

يعتبر مرض السكري من النوع الثاني والتهاب المفاصل العظمي من أكثر لأمراض شيوعا في العراق بشكل خاص وفي العالم بشكل عام، وهناك العديد من العوامل التي تؤدي إلى الإصابة بهذين المرضين اللذين يعتبران مشكلة العصر. السمنة والشيخوخة هي الأسباب الرئيسية لهذين المرضين بالإضافة إلى العديد من الأسباب الأخرى مثل نمط الحياة الخاطئ ، وعدم ممارسة الرياضة ، وما إلى ذلك من الاسباب الكثيرة . لقد تم قياس بعض الاختبارات المتعلقة بالمرضين لتحديد مدى العلاقة بينهما ، حيث تم قياس نسبة السكر في الدم والسكر التراكمي لمرض السكري بينما تم قياس بروتين عالي الحساسية وألبومين والفوسفاتيز القلوي. لمجموعة من النساء تضمنت المجموعة الأولى 50 امرأة مجموعة المرضى و40 امرأة كمجموعة اصحاء تتراوح اعمارهن من(40-70)وقد أظهرت النتائج وجود فرق معنوي بين مجموعة المرضى ومجموعة التحكم في الفوسفاتيز القلوي وهرمون الغدة الدرقية والبروتين التفاعلي C عالي الحساسية .($p<0.05$) هناك اختلافات كبيرة في Alb والكالسيوم ($p<0.01$) ، Albوذات دلالة سلبية مع .(P<0.05) PTH فروق ذات دلالة إحصائية في البروتين التفاعلي عالي الحساسية والفوسفور.(P<0.05)

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Evaluation the Effectiveness of *Nephelium lappaceum (Nl)* Peel Aqueous Extract Against Hepatocellular Carcinoma Induced by Thioacetamide (TAA) in Male Albino Rats

Zahraa Fadel Thabet[1]* , Heba A. Abd-Alsalam Alsalame[2]

[1,2]*Department of Biology , collage of education for pure science , University of Karbala, Karbala, Iraq*

P A P E R I N F O

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A B S T R A C T

This study aims to evaluate the effectiveness of *Nephelium lappaceum (Nl)* peel aqueous extract against liver cancer induced by Thioacetamide (TAA). This study has been conducted in the College of Education for Pure Sciences / University of Karbala and the animal house of Pharmacy College / University of Karbala for the period from the beginning of November 2023 until February 2024 , and the Physiological tests have been done in Al-Husseini Teaching Hospital in the Holy Karbala Governorate / Department of Clinical Chemistry. 40 male rats (12 weeks old , weighing 250 grams) are divided into four groups. First group (G1) is administered distilled water, the second group (G2) is injected 200 mg/kg Thioacetamide (TAA) while the third group (G3) is administered 25mg/kg *Nephelium lappaceum (Nl)* peel aqueous extract. Fourth group (G4) is administered 25mg/kg *Nephelium lappaceum (Nl)* peel aqueous extract with 200mg/kg Thioacetamide (TAA). After 90 days, blood samples are collected to study the following parameters: alkaline phosphatase (ALP), aminotransaminase transfer (ALT), aspartate transaminase (AST) and total bilirubin (TB) in addition to investigate the histological changes. The results show that TAA causes a significant increase ($P < 0.01$) in ALT, AST, ALP and T–BIL in (G2) compared with the (G1). While there is no significant increase ($P > 0.01$) in ALP, ALT, AST and T -BIL in G3 and G4 compared with the control. The results of the histological examination in G2 group reveal that treatment with TAA for 90 days leads to many noxious effects on liver cells with the appearance of many tumor nodules, vacillation and necrosis with infiltration of inflammatory cells. The study concludes that peel aqueous extract of *Nephelium lappaceum (Nl)* has a protective role against liver cancer induced by TAA in male rats.

1. INTRODUCTION

Thioacetamide (TAA) is a white or yellowish crystalline organic compound that is soluble in water. It contains sulfur, with a chemical molecular formula (CH3CSNH2). It is one of the chemical substances that is widely used in many experimental studies due to its high toxicity which causes cellular damage, especially liver damage, liver tumors, and cirrhosis in laboratory rats [1]. The existence of pollutants and toxins in the environment, such as TAA, which is commonly found in the food and beverage industries, laboratory treatments, and in the paper and automobile fuel industries [1,2]. In addition to its use as a fungicide and also in the textile industry,TAA is metabolized in the liver via cytochrome p 450 to produce highly reactive TAA-S-oxide and TAA-SS-oxide resulting the inflammation and oxidative stress in addition to their role as a carcinogen for man body's organs that include the liver [3,4]. Hepatocellular carcinoma (HCC) is the most common primary liver tumor and the fourth highest cause of cancer- related death globally, as it is directly linked to the increased production of free radicals [5,6]. Currently, medicinal plants are getting more importance because they cover many effective compounds that are utilized as complementary and alternative therapies with other treatments [7]. These plants comprise numerous antioxidant chemical compounds produced in the form of secondary metabolites that are protected from free radicals and oxidative stress associated with the appearance of cancer [8,9]. Among the types of these plants is the Rambutan (*Nephelium lappaceum NI*).This plant is considered one of the most antioxidant medicinal plants, whose fruits are characterized by being rich in many

*Corresponding Author Institutional Email:zahraa.fadhel@s.uokerbala.edu.iq (Zahraa Fadhel Thabet)

active compounds such as phenols, flavonoids, ascorbic acid, geranin, and others which enable it to scavenge reactive oxygen species (ROS). These species have an essential role in the treatment of many disease especially cancer, diabetes, and cardiovascular diseases, as well as having anti-inflammatory, antimicrobial, and cholesterol-lowering activity [10-12]. Further more, the anti-tumor activity of the Rambutan fruit is known for its capacity to inhibit the growth of cancer cells by activating the programmed apoptosis pathway and destroying the DNA of cancer cells.Accordingly, numerous previous studies have shown the role of rambutan fruits in combating aging and regulating blood sugar levels [13,14].

2. MATERIALS AND METHODS

2.1 Animals

Forty male albino white rats (age: 10-12 weeks, average weight: 200-250 grams) were obtained from animal houses in Karbala, Iraq. They were placed in special plastic cages, and their floors were spread with fine sawdust. The rats were kept under standard laboratory conditions at a temperature25°C with controlled humidity and 12/12 light-dark cycle, with the lights turned on at 8:00 A:M. Rats were monitored daily, with a standard diet including concentrate pullet and tap water.

2.2 Liver cancer induction

Thioacetamide (TAA) was purchased from Mumbai, India, and injected subperitoneal at a concentration of 200 mg/kg into male albino rats for 90 days according to [4].

2.3 Experience design

Forty adult males were divided into 4 groups (10 animals per group). First negative Group(G1) was given distilled water, Second positive group (G2) was injected Sub peritoneal injections with TAA at a concentration of 200 mg/kg twice a week, while the third group (G3) was administered 25 mg/kg of *NI* peels aqueous extract.The fourth group (G4) was administered 25 mg/kg of *Nl* peels aqueous extract with Sub peritoneal injections 200 mg/kg of TAA. After 90 days, all the animals were anesthetized after being given a piece of cotton and placed in a closed transparent box. The animals were dissected, and the liver organ was removed and cut into small pieces longitudinally and transversely. They were preserved in formalin at a concentration of 10% at 48 h. Later, the specimens were processed during the stander prosedure by using histological techniques [15].

2.4 Aqueous extract Preparation

20 g of dry powder of rambutan peels were added with 300 ml of DW. The mixture was left for 24 hours at room temperature. The mixture was filtered by using several layers of medical gauze.Then, it was centrifuged for 10 minutes at 3000 rpm.After that, the extract was cleared by using Whatman No. 0.1 to obtain a clear solution and dried at room temperature for12 hours.Finally, it was kept in glass bottles in the refrigerator until its use [16].

2.5 Statistical analysis

SPSS program was employed to analyze the results and the researchers tested the correlation coefficient by means of the analysis of variance by complete randomized design (CRD). They used the least significant difference (L.S.D) to show the importance of the results [17].

3. RESULTS

The results revealed a significant increase ($P<0.01$) in the liver enzyme level (ALP, AST, ALT and T-BIL) in (G2), which was treated with TAA 200 mg/kg for 90 days compared with (G1). The outcomes of the third and fourth groups showed that there were no noteworthy differences ($P>0.01$) in enzymes liver and T-BIL, as shown in the table (1).

TABLE 1. The effect of thioacetamide and Rambutan peel aqueous extract on ALT,AST,ALP and T-BIL in the serum of male rat.

Parameter	G1control group	G2 treated with 200mg/kg TAA	G3 treated with 25mg/kg NI peel aqueous extract	G4 treated with 200mg/kg TAA +25mg/kg NI peel aqueous extract
ALP(U/L)	231.50 ± 7.46 a	501.80 ± 33.89 b	232.40 ± 4.77 a	247.40 ± 10.47 c
AST(U/L)	128.10 ± 5.57 a	311.70 ± 39.72 b	124.30 ± 5.70 a	132.80 ± 4.37 a
ALT(U/L)	44.80 ± 5.31 a	114.40 ± 9.62 b	44.50 ± 4.01 a	48.20 ± 4.10 a
T_BIL	0.17 ± 0.03 a	0.64 ± 0.12 b	0.14 ± 0.04 a	0.18 ± 0.08 a

Mean± standard error

The histological structure of the control group shows several lobules containing a central vein and regularity of hepatocytes with normal bands and sinusoids as well as clear nuclei along with the central vein and sinusoids as in Figure (1).On the other hand , the results of histological of

the G2 group injected with a TAA showed the appearance of clear tumor nodules and the occurrence of degenerative changes as Figure (2). The consequences of histological treated with TAA and *NI* peels aqueous extract exposed enhancements in the changes induced by TAA, the normal structure of the liver and no apoptotic cells as Figure (3). Histological result of G4 group exhibited the normal structure of the liver cell as Figure (4).

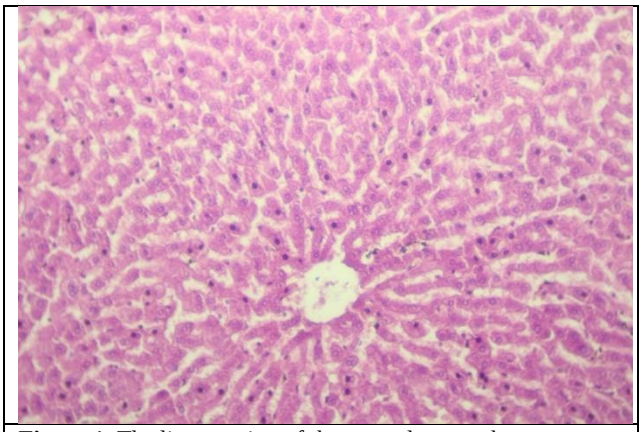

Figure 1. The liver section of the control group shows a central vein and regularity of hepatic lobules (H&E 100×).

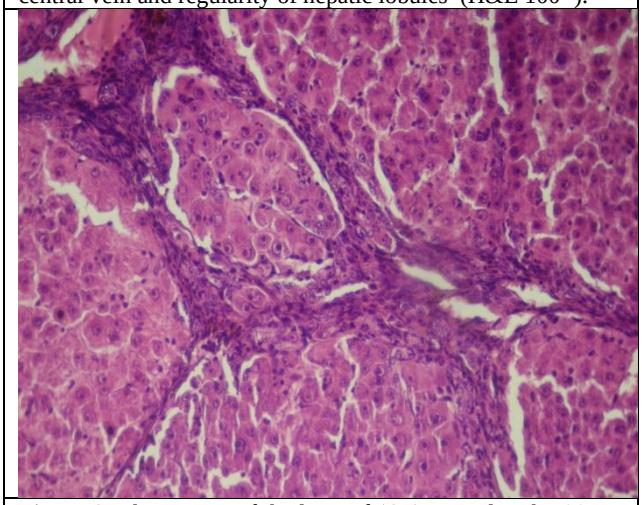

Figure 2. The section of the liver of (G2) treated with 200 mg /kg of TAA shows degenerative changes in the liver tissue and the appearance of large tumor nodules and infiltration of inflammatory cells with the occurrence of cell necrosis hepatic cells and congestion of central vein (H&E 200×).

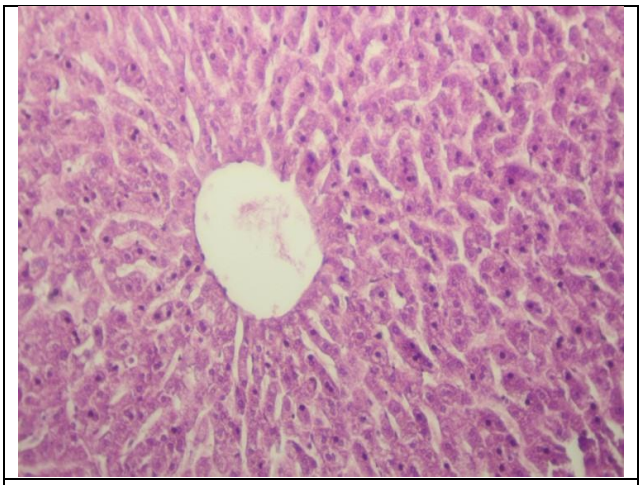

Figure 3. Show the effect of oral dosage with 25 mg/kg of *NI* peel aqueous extract which shows the normal structure of liver tissue and the normal appearance of hepatocytes with dilatation of the central vein (H&E 200×).

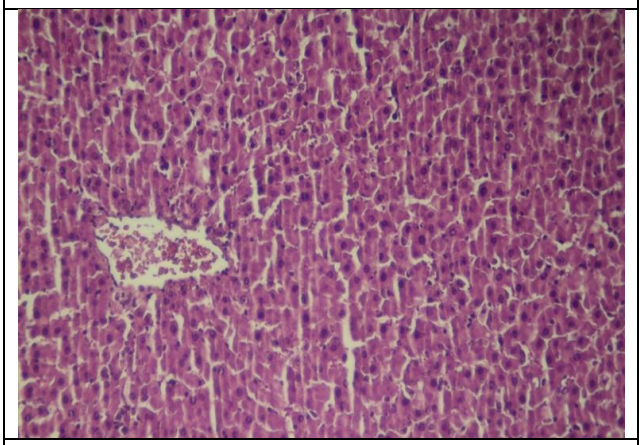

Figure 4. Section of the liver in rats injected with 200 mg/kg of TAA + 25 mg/kg of *NI* peel aqueous extract, showed the normal structure of the liver tissue was noticed with the reorganization of the hepatic chords with congestion of central vein (H&E 200×).

4. DISSCAION

The elevated level of liver enzymes due to acute toxic effect exerted by TAA, that causes severe oxidative stress to the liver cells and an increase in the level of free radicals (ROS) which occurs because of the depletion of the endogenous antioxidant GSH and SOD [18-20]. This leads to cellular damage, and necrosis in the liver cells, cirrhosis, as well as breakdown of the cell membrane, resulting in leakage of liver enzymes out of the liver cells, and an increase in the level of these enzymes in the blood [21-23]. Cytochrome 450 system participates in the bioactivation of the TAA.This leads to generating the toxic reactive metabolite (TAASO2). The toxic reactive metabolite forms acetylimidolysine derivatives, that cause cellular toxicity by binding to macromolecules in the liver

especially lipid. This leads to an increase in lipid peroxidation, Plasma membrane breakdown and an increase of enzymes released from liver cell [24]. In addition, change in the permeability and fluidity of the cell membrane takes place for its association $TAASO_2$ with calcium ions (Ca^{+2}), whose concentration increases inside the cells causing a defect in the transport and exchange of ions.This causes swelling and cellular dissolution , leads to damage enzymes in the cytosol and then release these enzymes into the bloodstream [24,18]. Bilirubin is the breakdown product of heme and the liver organ responsible for filtering bilirubin from the blood. It binds to albumin and transports to the liver where it is conjugated with glucuronic acid and secreted in the bile through the intestine [25]. The current study showed increased bilirubin levels that may due to the toxic effect of TAA by preventing the conversion of bilirubin (insoluble) by glucuronic acid into the water-soluble conjugated forms, which are monoglucuronide bilirubin and diglucuronide bilirubin.This issue leads to their non-excretion in the bile duct and accumulation in the serum and tissues [26]. The use of Rambutan peel extract led to the preservation of the normal structure of the liver , repairing of damaged cell membranes and regulation of the level of liver enzymes because of the antioxidants that rambutan peels contain comprising phenolic compounds.These compounds have the ability to reduce the free radical effect. The compound acts as an electron donor for H+ from its hydroxyl group, which leads to reducing the production of free radicals and making them more stable [27,28]. The peels also contain many active compounds, such as ellagic, corellagen, gallic, and flavonoids, which can neutralize reactive oxygen species (ROS), increase activities of internal antioxidants enzymes such as GSH and SOD, and enhance their synthesis, in additionto scavenging free radicals [29]. More over, geranin, which constitutes the largest portion of the compounds found in the peels of rambutan, has high activity in scavenging free radicals and reducing oxidative stress caused by TAA, which indicates the stability of cell membranes and the preservation of the secretory functions hepatic cells with the integrity of the bile duct [30]. In conclusion, *NI* peel aqueous extract that improves the defense status against oxidative stress against hepatotoxicity, has high antioxidant activity, and reduces hepatic tissue damage. It has great preventive importance in preserving hepatic tissue from damage caused by TAA.

5.REFERENCES

1. ElBaset, M. A., Salem, R. S., Ayman, F., Ayman, N., Shaban, N., Afifi, S. M., ... & Elalfy, Z. S., “Effect of empagliflozin on thioacetamide-induced liver injury in rats: role of AMPK/SIRT-1/HIF-1α pathway in halting liver fibrosis’’. Antioxidants. 2022; 11(11), 2152.
2. Ebaid, H., Bashandy, S. A., Morsy, F. A., Al-Tamimi, J., Hassan, I., & Alhazza, I. M., “Protective effect of gallic acid against thioacetamide-induced metabolic dysfunction of lipids in hepatic and renal toxicity’’. Journal of King Saud University-Science. 2023; 35(3), 102531.
3. Ibrahim, M. Y., Alamri, Z. Z., Juma, A. S., Hamood, S. A., Shareef, S. H., Abdulla, M. A., & Jayash, S. N., “Hepatoprotective Effects of Biochanin A on Thioacetamide-Induced Liver Cirrhosis in Experimental Rats’’. Molecules.2023; 28(22), 7608.’
4. Elshahawy, Z. R., Saad, E. A., & El-Sadda, R. R., “Synergistic impacts of rifampicin and doxorubicin against thioacetamide-induced hepatocellular carcinoma in rats”. Liver Research. 2023; 2542-5684.
5. Calderaro, J. Ziol, M. Paradis V, & Zucman-Rossi J. “Molecular and histological correlations in liver cancer’’. Journal of hepatology.2019; 71 (3), 616-630.
6. Morris V. K. , Overman, M. J., Lam, M., Parseghian, C. M., Johnson, B., Dasari, A., ... & Kopetz, S. Bintrafusp Alfa, an Anti-PD -L1: TGFβ Trap Fusion Protein, in Patients with ctDNA-positive, ”Liver-limited Metastatic Colorectal Cancer. Cancer research communications’’. 2022; 2(9), 979-986.
7. Pammi, S. S., Suresh, B., & Giri, A., ‘’Antioxidant potential of medicinal plants’’. Journal of Crop Science and Biotechnology. 2023; 26(1), 13-26.
8. Ur Rehman, F. Kalsoom ,M. Adnan M, Fazeli-Nasab B, Naz N, Ilahi H., ... & Toor MD. “Importance of medicinal plants in human and plant pathology”: A review. Int. J. Pharm. Biomed. Res. 2021; 8, 1-11.
9. Rasool, A., Bhat, K. M., Sheikh, A. A, Jan, A., & Hassan, S. “Medicinal plants: Role, distribution and future’’. Journal of Pharmacognosy and Phytochemistry. 2020; 9(2), 2111-2114.
10. Afzaal, M., Saeed, F., Bibi, M., Ejaz, A., Shah, Y. A., Faisal, Z., ... & Shah, M., A.,”Nutritional, pharmaceutical, and functional aspects of rambutan in industrial perspective: An updated review’’. Food Science & Nutrition. 2023; 11:3675–3685.
11. Jahurul, M. H. A., Azzatul, F. S., Sharifudin, M. S., Norliza, M. J., Hasmadi, M., Lee, J. S., Patricia, M., Jinap, S., George, M. R., Khan, M. F., & Zaidul, I. S. M., “Functional and nutritional properties of ram-butan (Nephelium lappaceum L.) seed and its industrial application: A review’’. Trends in Food Science & Technology. 2020; 99, 367– 374.
12. Gapsari, F., Darmadi, D.,B., Setyarini, P. H., Izzuddin, H., Madurani, K. A., Tanji, A., & Hermawan, H., “Nephelium lappaceum extract as an organic inhibitor to control the corrosion of carbon steel weldment in the acidic environment’’. Sustainability. 2021; 13(21), 12135.
13. Tsong, J. L., Goh, L. P. W., Gansau, J. A., and How, S. E., “Review of Nephelium lappaceum and Nephelium ramboutan-ake: a high potential supplement. Molecules’’. 2021; 26(22), 7005.
14. Hernández-Hernández, C., Aguilar, C. N., Rodríguez-Herrera, R., Flores-Gallegos, A. C., Morlett-Chávez, J., Govea-Salas, M., & Ascacio- Valdés, J. A., “Rambutan (Nephelium lappaceum L.): Nutritional and functional properties’’. Trends in Food Science & Technology. 2019; 85, 2 01– 210.
15. Bancroft, J. D., and and Stevens, A., “Theory and practice of histological techniques 2nded”. churchill livingstone. XiV+ 647. Am .Fam. Physician, 2010 ; 54(3), 986–992.
16. Hernandezi, M., Lopez, R., Abanas, R. M. V., and Arias, A., “Antimicrobial activity of visnea mocanera leaf extracts j”. Ethno pharma cology .1994; 41 .115-119.
17. Spss .(1999). Statistical packages social sciences , Verion 10 .USA
18. Unnisa, A., Khan, S. L., Sheikh, F. A., Mahefooz, S., Kazi, A. A., Siddiqui, F. A., ... & Saboo, S. G., “In-silico inhibitory potential of triphala constituents against

cytochrome P450 2E1 for the prevention of thioacetamide-induced hepatotoxicity". Journal of Pharmaceutical Research International. 2021; 33(43A), 367-375.
19. Shareef, S. H., Ibrahim, I. A. A., Alzahrani, A. R., Al-Medhtiy, M. H., & Abdulla, M. A., "Hepatoprotective effects of methanolic extract of green tea against Thioacetamide-Induced liver injury in Sprague Dawley rats". Saudi journal of biological sciences. 2022; 29(1), 564-573.
20. El-Demerdash, F. M., Al Mhanna, A. B., El-Sayed, R. A., Mohamed, T. M., Salem, M. M., "Hepatoprotective impact of Nigella sativa silver nanocomposite against genotoxicity, oxidative stress, and inflammation induced by thioacetamide". Tissue and Cell. 2024 Feb 15:102332.
21. Alamri, Z. Z., "Protective and therapeutic effects of apigenin on thioacetamide-induced hepatotoxicity in male rats: physiological and morphological study". Egyptian Liver Journal. 2024; 14(1), 1-14.
22. Sepehrinezhad, A., Shahbazi, A., Negah, S. S., Joghataei, M. T., & Larsen, F. S., "Drug-induced-acute liver failure: A critical appraisal of the thioacetamide model for the study of hepatic encephalopathy". Toxicology Reports. 2021; 8, 962-970.
23. Jabbar, A. A., Alamri, Z. Z., Abdulla, M. A., AlRashdi, A. S., Najmaldin, S. K., & Zainel, M. A., "Sinapic Acid Attenuate Liver Injury by Modulating Antioxidant Activity and Inflammatory Cytokines in Thioacetamide-Induced Liver Cirrhosis in Rats". Biomedicines. 2023; 11(5), 1447.
24. Moustafa, A. H. A., Ali, E. M. M., Moselhey, S. S., Tousson, E., & El-Said K. S.," Effect of coriander on thioacetamide-induced hepatotoxicity in rats". Toxicology and industrial health.2014; 30(7), 621-629.
25. Hadeer, A. A., & AL-Kaisie, B. I.," Pathological and biochemical study on liver of male mice intoxicated with thioacetamide". J Entomol Zool Stud. 2018; 6, 1436-1441.
26. Abouelezz, H. M., Shehatou, G. S., Shebl, A. M., & Salem, H. A., "A standardized pomegranate fruit extract ameliorates thioacetamide-induced liver fibrosis in rats via AGE-RAGE-ROS signaling". Heliy. 2023; 9(3).
27. Luthfiya, I., Puspita, O. S., Nugraha, Y., & Fahrudin, F., "Rambutan Fruit Peel Extract Reduces Abnormal Sperm Morphology in Male Wistar Rats with Obesity". Al-Kauniyah: Jurnal Biologi. 2023; 16(2), 347-355.
28. Samuagam, L., Sia, C. M., Akowuah, G. A., Okechukwu, P. N., & Yim, H. S., "In vivo antioxidant potentials of rambutan, mangosteen, and langsat peel extracts and effects on liver enzymes in experimental rats". Food Science and Biotechnology. 2015; 24, 191-198.
29. de Santana Santos, A., de Souza Oliveira, A. K., Pereira, R. O., Junior E. V. B., de Lima Sayão, A., & de Oliveira e Silva A. M., "Composition and Biological Properties of Rambutan (Nephelium lappaceum)". Phytopharmaceuticals: Potential Therapeutic Applications. 2021; 403-436.
30. Sholikhah, A. M. N., "Study of Pharmacological Activities and Chemical Content of Rambutan (Nephelium Lappaceum L.) Fruit Peel Extract: A Systematic Review". In 4th International Conference Current Breakthrough in Pharmacy (ICB-Pharma). 2022; pp. 251-260. Atlantis Press.

Arabic Abstract

هدفت الدراسة إلى تقييم فعالية المستخلص المائي لقشور *Nephelium lappaceum (Nl)* ضد سرطان الكبد المستحث بواسطة الثيواسيتاميد (TAA). أجريت هذه الدراسة في كلية التربية للعلوم الصرفة / جامعة كربلاء وبيت الحيوان التابع لكلية الصيدلة / جامعة كربلاء للمدة مابين بداية تشرين الثاني 2023 ولغاية شباط 2024، وأجريت الاختبارات الفسيولوجية في مستشفى الحسيني التعليمي في محافظة كربلاء المقدسة / قسم الكيمياء السريرية. اربعين من ذكور الجرذان البيض (عمرها 12 أسبوع، تزن 250 جرام) قسمت إلى أربع مجموعات، المجموعة الأولى (G1) تم تجريعها بالماء المقطر، المجموعة الثانية (G2) تم حقنها بـ 200 ملجم/كجم من الثيواسيتاميد (TAA)، اما المجموعة الثالثة فقد جرعت بالمستخلص المائي لقشور(*Nephelium lappaceum (Nl)*، المجموعة الرابعة (G4) جرعت 25 ملغم/كغم بالمستخلص المائي لقشور *Nephelium lappaceum (Nl)* مع 200 ملغم/كغم من الثيوأسيتاميد (TAA). بعد 90 يوما، تم جمع عينات الدم لدراسة المستويات التالية: انزيم الفوسفاتيز القاعدي (ALP)، الانزيم الناقل للأمين (ALT)، الانزيم الناقل للأسبارتات (AST)، البيليروبين الكلي (TB) بالإضافة إلى دراسة التغيرات النسيجية. أظهرت النتائج أن TAA قد سبب ارتفاع معنوي ($P < 0.01$) في ALT وAST وALP وT-BIL في (G2) مقارنة مع مجموعة السيطرة (G1). بينما لم يكن هناك فرق معنوي ($P > 0.01$) في مستوى ALP وALT وAST وT-BIL في G3 وG4 مقارنة مع مجموعة السيطرة. أظهرت نتائج الفحص النسيجي لمجموعة G2 أن المعالجة بـ TAA لمدة 90 يوماً سبب العديد من التأثيرات الضارة على خلايا الكبد مع ظهور العديد من العقيدات الورمية وتفجي والنخر الخلوي مع ارتشاح الخلايا الالتهابية. نستنتج من هذه الدراسة أن المستخلص المائي لقشور نبات *Nephelium lappaceum (Nl)* كان له دور وقائي ضد سرطان الكبد المستحث بمادة TAA في ذكور الجرذان البيض.

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Evaluation of Lipid Profile, Urea and Creatinine in Hypertensive Patients

Rasha Abbas Abdel Hussein[1*], Rehab Jasim Mohammed[2], Lamia Abdel Karim Darwish[3]

[1,2] *Department of chemistry, Collage of Education for Pure Science, University of Kerbala, Kerbala, Iraq.*
[3] *Faculty of Medicine, University of Al-Ameed, Kerbala, Iraq.*

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A B S T R A C T

Hypertensive is a common disease that can be dangerous if left untreated. Also, many factors can cause high blood pressure, including high fat content. There is a strong relationship between high blood pressure and kidney weakness,This is because uncontrolled hypertensive is a major reson for chronic kidney disease.This study included 50 patients who were suffering from hypertensive and 40 individuals from the healthy control group. 50 patients who were suffering from high blood pressure, 28 males and 22 females, with ages ranging from 40 to 70 years, participated in this study. They were compared with the healthy group. The parameters measured in these groups were cholesterol and triglycerides and (LDL, HDL, VLDL) and urea and creatinine. The results of this study showed a significant difference when comparing the data of patients with high blood pressure with the group of healthy people. It is noticed that most of the analyzes were higher than the normal limit, which included cholesterol and triglycerides , (LDL, HDL, VLDL), urea, and creatinine in patients with hypertensive. The P value was in ≤ (0.0001).

1. INTRODUCTION

Blood pressure is the force with which blood pushes against the walls of blood vessel [1,2]. This force changes, and it is the highest when the heart contracts to pump blood to the body (systolic blood pressure), and decreases during a period when the heart stops contracting (diastolic blood pressure) [3]. Therefore, the blood pressure measurement result consists of two numbers, for example 130 over 85 mmHg. Changes in these numbers have a “normal range” [4]. Hypertensive is an increase in one or both of these numbers above the upper limit of normal [5].Accordingly, hypertensive is a condition in which there is an increase in the force with which blood pushes against the walls of blood vessels as it flows to reach the body's organs [6]. The heart, which requires it to exert more effort to pump blood into arteries with high pressure. Consequently, the strength of the heart weakens, and the heart muscle swells and becomes fibrous [7]. Blood vessels face a high force that exerts internal pressure on their walls, causing damage to their structure, decreased elasticity, and increased stiffness [8]. Organs of the body that receive blood with a high impulse force damage their anatomical structure and impair their functional efficiency [9]. High triglycerides and hypertensive occur as a result of the accumulation of fats on the walls of blood vessels and arteries, causing them to narrow, impeding blood circulation, and causing high blood pressure [10]. Hypertensive due to triglycerides affects the blood vessels and causes damage, which increases the effort on the heart muscle and leads to many complications. Many chronic diseases are linked to each other, and their diagnosis usually coincides at the same time, as high cholesterol is linked to many heart and arterial diseases, especially hypertensive [11,12]. The high blood pressure and cholesterol have a close relationship on many levels. High blood pressure often occurs because of the high levels of cholesterol [13]. Likewise, high blood pressure, individually, is a risk factor that increases the chance of developing heart disease, and the presence of these two factors together at the same time doubles the risk of developing heart disease [14,15]. The risk is still existant even if cholesterol and blood pressure levels are relatively slightly high since the presence of both causes damage to blood vessels and weakens the heart muscle more quickly [16,17].

2. METHODS

This study was conducted in the Department of Internal Medicine Consultation Clinic at Imam Hussein Teaching Hospital in Karbala Governorate. The study

*Corresponding Author Institutional Email:
m03163114@uokerbala.edu.iq (Rasha Abbas Abdel Hussein)

included 40 healthy people and 50 patients suffering from hypertensive. The a greet of the patients and healthy included were 40-70 years. The study extended from October 2023 to February 2024 and included information (name, age, gender, height, weight, duration of disease and other diseases, as well as the treatment used). This study measured the percentage of fats in the blood, lipid profile, as well as the percentage of urea and creatinine in the blood in order to determine the efficiency of the kidneys. Samples were collected by taking the patient's oral consent and withdrawing 5 ml of venous blood and analyzed by kit.

3.STATISTICAL ANALYSIS

The data were analyzed using SAS software and the results were compared by using the least significant difference (LSD) value at the probability level of 0.05 and 0.0001 [18].

4.RESULTS

TABLE 1. Comparison of the lipid profile, which covers cholesterol, triglycerides, LDL, HDL, and VLDL, as well as urea and creatinine, between patients and the control group.

Parameter	Subject	Means ± S.D	P value
Age(years)	Patient	11.5 ± 0055.	N.S
	control	52.00 ± 6.30	
Cholesterol(mg/dl)	Patient	10.55 ± 00.197	0.0001
	control	69.18 ± 48.132	
Triglycerides(mg/dl)	Patient	88.73 ± 73.175	0.0001
	control	19.22 ± 11.97	
VLDL(mg/dl)	Patient	72.14 ± 93.34	0.0001
	control	22.5 ± 73.19	
LDL(mg/dl)	Patient	06.68 ± 61.196	0.0001
	control	01.39 ± 57.77	
HDL(mg/dl)	Patient	47.6 ± 62.40	0.0001
	control	21.36 ± 37.76	
Creatinine(mmol/L)	Patient	41 ± 0.880.	0.0001
	control	27 ± 0.700.	
Urea(mmol/L)	Patient	33.11 ± 27.33	0.0001
	Control	66.5 ± 68.22	

TABLE 2. Comparison of the lipid profile, which contains cholesterol, triglycerides, LDL, HDL, and VLDL, as well as urea and creatinine, between male and female patients.

Parameter	Subject	Means ± S.D	P value
Triglycerides (mg/dl)	Man	07.79 ± 26.173	0.0001
	Woman	44.22 ± 48.103	
Cholesterol(mg/dl)	Man	46.55 ± 68.195	0.0001
	Woman	64.20 ± 05.133	
VLDL(mg/dl)	Man	68.15 ± 21.34	0.0001
	Woman	62.5 ± 26.21	
LDL(mg/dl)	Man	17.67 ± 03.208	0.0001
	Woman	95.37 ± 13.97	
HDL(mg/dl)	Man	19.6 ± 63.38	0.0001
	Woman	26.34 ± 94.59	
Creatinine(mmol/L)	Man	48.0 ± 01.1	0.0001
	Woman	31 ± 0.730.	
Urea(mmol/L)	Man	30.10 ± 73.36	0.0001
	Woman	38.6 ± 47.22	

No.of man=28

No.of woman=22

TABLE 3. Comparison of the lipid profile, which includes cholesterol, triglycerides, LDL, HDL, and VLDL, as well as urea and creatinine, between patients aged 40-55 and the ones aged 56-70.

Parameter	Subject	Means ± S.D	P value
Triglycerides(mg/dl)	40 – 55	34.71 ± 91.164	N.S
	56 – 70	89.76 ± 35.190	
VLDL(mg/dl)	40 – 55	11.14 ± 61.32	N.S
	56 – 70	37.15 ± 61.38	
LDL(mg/dl)	40 – 55	85.67 ± 26.207	N.S
	56 – 70	65.67 ± 20.182	
HDL(mg/dl)	40 – 55	16.7 ± 39.42	0.05
	56 – 70	60.4 ± 23.38	
Cholesterol(mg/dl)	40 – 55	95.61 ± 00.197	N.S
	56 – 70	06.40 ± 00.197	
Creatinine(mmol/L)	40 – 55	40.0 ± 83.0	N.S
	56 – 70	43 ± 0.950.	
Urea(mmol/L)	40 – 55	01.11 ± 60.32	N.S
	56 – 70	02.12 ± 14.34	

TABLE 4. Comparison of the lipid profile, which includes cholesterol, triglycerides, LDL, HDL, and VLDL, as well as urea and creatinine, between patients with high blood pressure only and patients with other diseases.

Parameter	Subject	Means ± S.D	P value
Triglycerides(mg/dl)	patients with Hypertension	47.67 ± 43.161	0.02
	patients Other diseases	73.80 ± 92.215	
VLDL(mg/dl)	patients with Hypertension	32.13 ± 00.32	0.03
	patients Other diseases	66.15 ± 53.42	
LDL(mg/dl)	patients with Hypertension	51.63 ± 02.176	0.01
	patients Other diseases	19.53 ± 03.248	
HDL(mg/dl)	patients with Hypertension	06.6 ± 25.40	N.s
	patients Other diseases	35.7 ± 15.41	
Cholesterol(mg/dl)	patients with Hypertension	86.52 ± 86.184	0.01
	patients Other diseases	12.51 ± 08.229	
Creatinine(mmol/L)	patients with	28.0 ± 79.0	0.04

	Hypertension patients	56 ± 0.061.	
	Other diseases		
Urea(mmol/L)	patients with Hypertension	87.10 ± 17.31	0.05
	patients Other diseases	86.10 ± 46.38	

* patient's Other diseases: diabetes, kidney disease, high lipid profile.

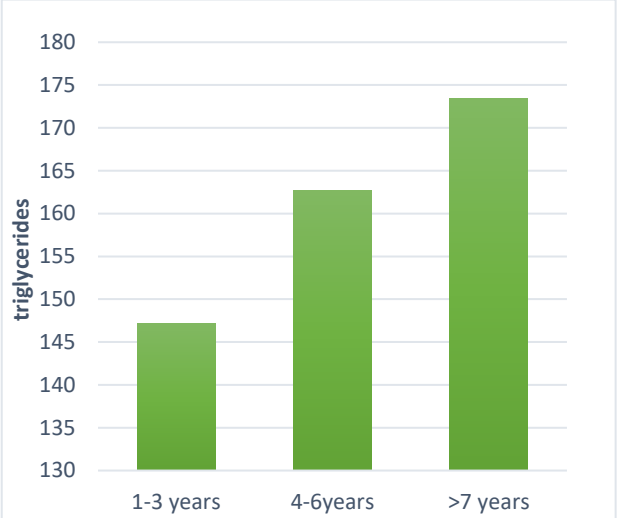

Figure 1. There ration between duration of hypertension and the level of triglycerides.

The relationship between triglycerides in patients with hypertension and the duration of their disease, as they were divided into 1-3 yrs, 4-6 years, and older than 7 yrs. The measurement revealed an increase in the percentage for the the duration of illness in patients with hypertension increased.

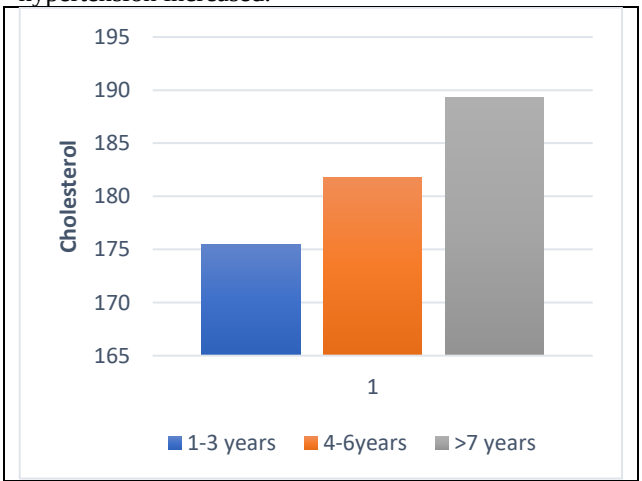

Figure 2. There ration between duration of hypertension and the level of Cholesterol.

The connection between Cholesterol in patients with hypertension and the length of their sickness as they were classified into 1-3 yrs, 4-6 yrs, and older than 7 yrs. The assessment show an increase in the Proportion as the length of illness in those with hypertension escalated.

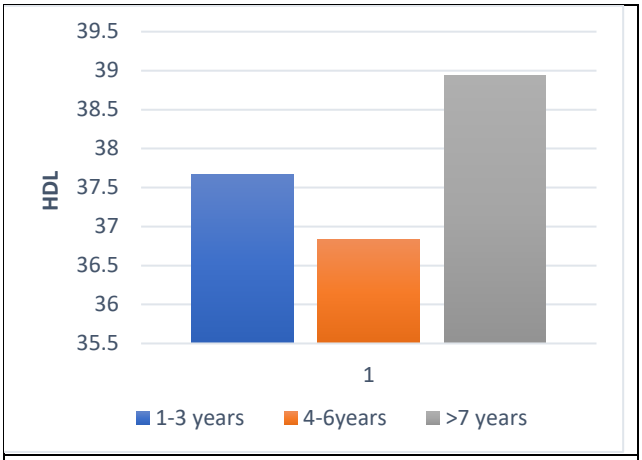

Figure 3. There ration between duration of hypertension and the level of HDL.

The connection between HDL in individuals with hypertension and the length of their illness, which was separated into 1-3 yrs, 4-6 yrs, and more than 7 yrs. The observation revealed a rise in the proportion over 1-3 yrs, following which the proportion decreased over a period of 4-6 yrs and then increased again over a period of more than 7yrs in patients suffering from hypertension..

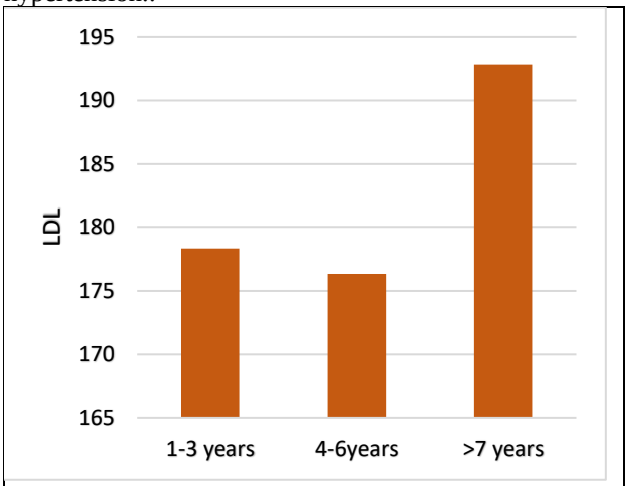

Figure 4. There ration between duration of hypertension and the level of LDL.

The association between LDL in hypertensive patients and the length of their ailment, which was classified as 1-3 yrs, 4-6 yrs, and more than 7 yrs. The assessment revealed a growth in the proportion in 1-3 yrs, followed by a decline in 4-6 yrs, and then a large increase in visits in patients with hypertension in more than 7 yrs.

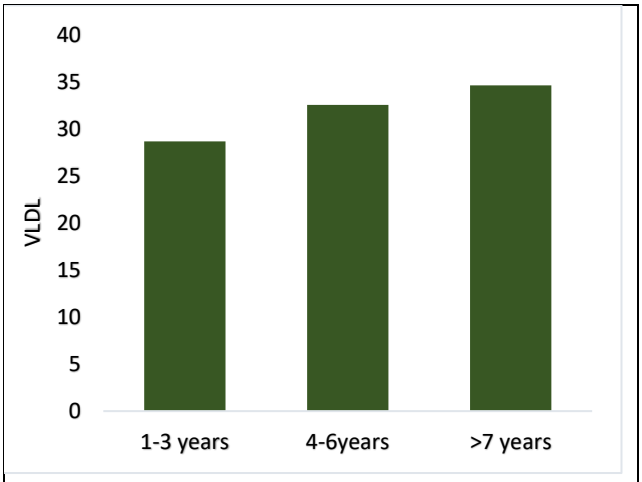

Figure 5. There ration between duration of hypertension and the level of VLDL

The association between VLDL in hypertension patients and the length of their condition, which was classified as 1-3 yrs, 4-6 yrs, and more than 7 yrs. The assessment revealed that the percentage increased with the duration of the ailment in hypertension patients.

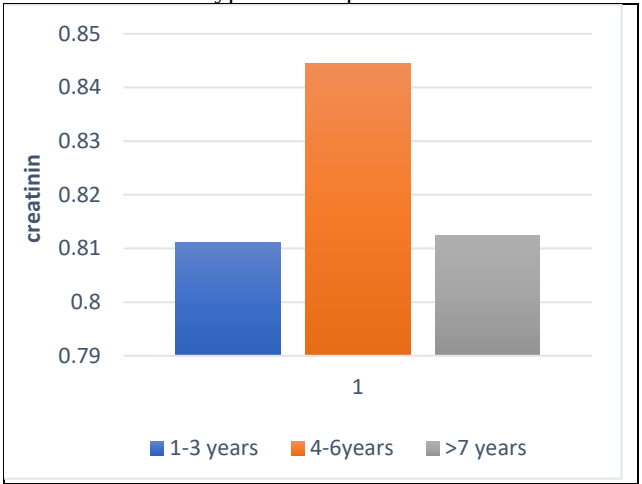

Figure 6. There ration between duration of hypertension and the level of creatinine.

The association between creatinine levels in hypertensive patients and the length of their ailment, which was classified as 1-3 yrs, 4-6 yrs, or more than 7 yrs. The assessment revealed an increase in the percentage over a period of 4-6 yrs in individuals suffering from hypertension.

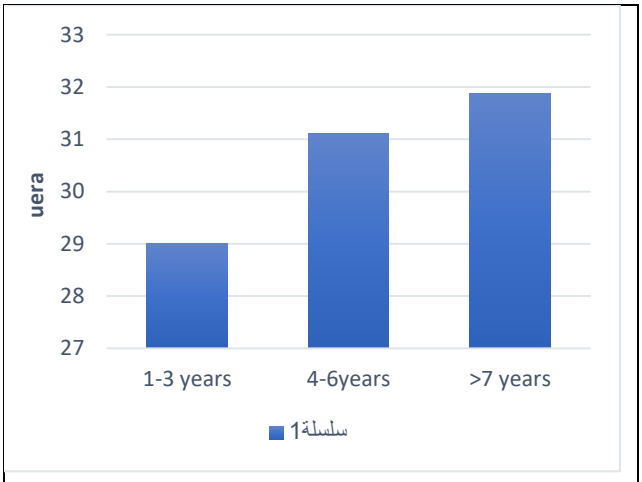

Figure 7.There ration between duration of hypertension and the level of urea.

The relationship between urea in hypertensive patients and the duration of their disease, which was divided into 1–3 years, 4–6 years, and more than 7 years. The measurement indicated an increase in the percentage with increasing duration of the disease in patients suffering from hypertensive.

5.DISCUSSION

The results of Table 1 Figure (2,5) showed a significant difference (P value = ≤ 0.0001) in cholesterol and triglycerides compared with the control group. It also (LDL, HDL, and VLDL). In hypertension individuals, the mean blood levels of triglycerides, total cholesterol, and low-density lipoprotein were considerably higher than their threshold values. Furthermore, according to these findings, aberrant levels of low-density lipoprotein, total cholesterol, triglycerides, and high-density lipoprotein were increasing in hypertension patients [19,20]. It also exposed a noteworthy difference (p=0.0001) in the percentage of urea and creatinine when compared with the control group. Patients with hypertensive suffer from high levels of Urea and creatinine result from fluid retention in the body Kidney damage or improper functioning [21].

The results of Table 2 Figure 3 presented a significant difference (P = 0.0001) in cholesterol and triglycerides, (LDL, HDL, VLDL) compared between men and women. The outcomes of the current study indicated a substantial difference (P = 0.0001) in creatinine and urea levels between men and women.Our findings concur with the findings of two Japanese research studies that have shown a favorable correlation between high blood pressure and HDL values [22]. Similarly, a research comprising over 190,000 French individuals under the age of 55 who had high blood pressure revealed that over 50% of them had dyslipidemia [23].

According to the results of hypertension screening conducted in the United States, dyslipidemia was present in 79% of white male and 65% of white female hypertension patients, which was higher than the percentages observed in black male and female hypertensive patients (57% and 50%, respectively) [24].Nigerians had a 64% incidence of elevated lipid profiles among hypertension patients [25].The average prevalence of lipid disorders in patients with hypertension in the Algerian population was 16.1%. [26]. The hypertension population in this study had a high lipid profile prevalence, which was comparable to previous research on the hypertensive population from rural northeastern China [27] and the rural Chinese community in Liaoning Province, China [28].

The results of Table 3 Figure [1,4] indicated that there was no significant difference in the percentage of cholesterol, triglycerides, and (LDL, VLDL) Creatinine, Urea according to the age group between 40-55 and 56-70, only a significant difference in the percentage of HDL ($p = 0.05$). These results agree with other researches showing that age is linked to the increase of blood pressure.They were carried out in both industrialized and developing nations [29, 30]. Furthermore, this investigation showed that in hypertension patients, age was strongly correlated with serum LDL [31, 32]. It is also supported by studies reporting a direct relationship between age and cholesterol levels [33, 34]. Blood pressure naturally rises with age, possibly as a result of changes in atherosclerotic endothelium cells and increasing atherosclerosis in the blood arteries. Wen & Co. Additionally, Wen & Co stated that atherosclerosis advances with age. Regarding people's age, there is a growing positive correlation between arterial stiffness and blood pressure [35] .The prevalence of atherosclerosis and hypertension rises with advancing age [36, 37].

The results of table 4 Figure [6,7] revealed that there was a significant difference ($p = 0.02$) in triglycerides, ($p = 0.03$) with VLDL, ($p = 0.01$) with LDL and cholesterol, Obesity, diabetes, and dyslipidemia are among the further cardiovascular risk factors that are frequently linked to hypertension. The pathogenesis of hypertension may involve endothelial dysfunction brought on by the presence of cardiovascular risk factors. [38] According to a research by Young et al., [39] insulin resistance has been shown to negatively affect blood pressure in older people and it may have a bigger effect than aging. Additionally, a correlation between plasma insulin concentrations and hypertension was noticed ($r = 0.31$, $p < 0.01$). [40] This study also revealed that hypertension individuals who consumed alcohol had higher average blood TC levels than those who did not. Furthermore, individuals with a smoking habit exhibited aberrant lipid levels.This result goes in line with a Greek research [41]. Worldwide, hypertension is recognized as a significant risk factor for diabetes, renal disease, heart disease, and stroke [42]. The results of the current study showed that there was significant difference in the percentage of ($p = 0.04$) with creatinine, ($p = 0.05$) with urea. as well as the absence of noteworthy difference with HDL compared to patients with other diseases. End-stage renal disease (ESRD) is more common and its incidence is increasing [43]. Renal function will ultimately gradually deteriorate in around one-third of those afflicted [44]. According to worldwide data on the prevalence of hypertension worldwide, in 2005, 20.6% of Indian men and 20.9% of Indian women reported having high blood pressure. By 2025, it is anticipated that these rates would increase to 22.9% and 23.6%, respectively, for Indian men and women [45]. Adequate blood pressure regulation is widely acknowledged to be crucial in avoiding cardiovascular disease and end-stage renal disease (ESRD) and reducing the course of chronic kidney disease (CKD) [46]. Long-term exposure to blood pressure increases, especially in normotensive settings, can cause early kidney injury since the kidneys are the first organ targeted for damage in hypertension [47]. The effect of duration of hypertension increases the risk and heart disease (Hardening and blockage of the arteries) and kidney disease [48].

6.REFERENCES

1- Malignant hypertension, MedlinePlus.com Available at : 'http://www.nlm.nih.gov/medlineplus/ency/article/000491.htm (https://web.archive.org/web/20160705053426/https://www.nlm.nih.gov/medlineplus/ency/article/000491.htm) 2016-07-05.

2- https://www.nhlbi.nih.gov/health/high-blood-pressure. Accessed July 18, 2022.

3- Flynn JT, et al. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. Pediatrics. 2017; doi:10.1542/peds.2017-1904.

4- Physical Activity Guidelines for Americans. 2nd ed. U.S. Department of Health and Human Services. https://health.gov/our-work/physical-activity/current-guidelines. Accessed June 15, 2022.

5- Hypertension in adults: Screening. U.S. Preventive Services Task Force. https://uspreventiveservicestaskforce .org/uspstf/ recommendation/hypertension-in-adults-screening. Accessed July 18, 2022.

6- Thomas G, et al. Blood pressure measurement in the diagnosis and treatment of hypertension in adults. https://www.uptodate.com/contents/search. Accessed July 18, 2022.

7- Muntner P, et al. Measurement of blood pressure in humans: A scientific statement from the American Heart Association. Hypertension. 2019; doi:10.1161/HYP.

8- Basile J, et al. Overview of hypertension in adults. https://www.uptodate.com/contents/search. Accessed July 22, 2022.

9- Know your risk factors for high blood pressure. American Heart Association. https://www.heart.org/en/health-topics/high-blood-pressure/why-high-blood-pressure-is-a-silent-killer/know-your-risk-factors-for-high-blood-pressure. Accessed July 18, 2022

10- AskMayoExpert. Triglycerides (adults). Rochester, Minn.: Mayo Foundation for Medical Education and Research; 2018.
11- AskMayoExpert. Hyperlipidemia (adult). Rochester, Minn.: Mayo Foundation for Medical Education and Research; 2018.
12- High blood triglycerides. National Heart, Lung, and Blood Institute. https://www.nhlbi.nih.gov/health-topics/high-blood-triglycerides. Accessed Aug. 7, 2018.
13- WebMD. Diseases Linked to High Cholesterol. Retrieved on the 17th of June 2023.
14- Colleen M. Story. What's the Connection Between High Blood Cholesterol and Hypertension? Retrieved on the 17th of June 2023.
15- Ryan Raman. 10 Herbs That May Help Lower High Blood Pressure. Retrieved on the 17th of June 2023.
16- Ruben O. Halper in, et al. (2005). Dyslipidemia and the Risk of Incident Hypertension in Men.
17- Jennifer Moll. Can High Blood Pressure Medications Affect Cholesterol? Retrieved on the 17th of June 2023.
18- SAS 2012. Statistical Analysis System, User`s Guide. Statistical. Version 9.1th ed. SAS. Institute Incorporated Cary. N.C. USA
19- Basile J, et al. Overview of hypertension in adults. https://www.uptodate.contents/search. Accessed Aug. 11, 2023.
20- Health threats from high blood pressure. American Heart Association. https://www.heart.org/en/health-topics/high-blood-pressure/health-threats-from-high-blood-pressure. Accessed Aug. 11, 2023.
21- S. S. Waikar, R. A. Betensky, and J. V Bonventre, "Creatinine as the gold standard for kidney injury biomarker studies?," Nephrology Dialysis Transplantation, vol. 24, no. 11. Oxford University Press, pp. 3263–3265, 2009
22- Oda E, Kawai R. (2011). High-density lipoprotein cholesterol is positively associated with hypertension in apparently healthy Japanese men and women. Br J Biomed Sci. 68: 29-33.
23- Thomas F, Bean K, Guize L, et al. Combined effects of systolic blood pressure and serum cholesterol on cardiovascular mortality in young (<55 years) men and women. Eur Heart J 2002 ;23:528–35.
24- McDonald M, Hertz RP, Unger AN, et al. Prevalence, awareness, and management of hypertension, dyslipidemia, and diabetes among United States adults aged 65 and older.
25- Adamu UG, Okuku GA, Oladele CO, et al. Serum lipid profile and correlates in newly presenting Nigerians with arterial hypertension. Vasc Health Risk Manag 2013;9:763–8. 10.2147/VHRM.S50690 [DOI (https://doi.org/10.2147/VHRM.S50690)].
26- Bachir Cherif A, Bennouar S, Bouamra A, et al. Prevalence of diabetes and dyslipidemia in hypertensive patients in the area of Blida (Algeria). Annales de Cardiologie et d'Angéiologie 2018;67:198–203.
27- Yu S, Yang H, Guo X, et al. Prevalence of dyslipidemia and associated factors among the hypertensive population from rural northeast China. BMC Public Health 2015;15:1152. 10.1186/s12889-015-2486-7 [DOI (https://doi.org/10.1186/s12889-015-2486-7)] [PMC free article (https://pmc.ncbi.nlm.nih.gov/articles/PMC4654887/)] .
28- Zhang X, Sun Z, Zheng L, et al. Prevalence of dyslipidemia and associated factors among the hypertensive rural Chinese population. Arch Med Res 2007;38:432–9. 10.1016/j.arcmed.2006.12.005 [DOI (https://doi.org/10.1016/j.arcmed.2006.12.005)] .
29- Reza CM, Kabir ASMA, Biswas T, et al. Status of lipid profile among the hypertensive patients in Bangladesh. Univ Heart J 2014; 9: 13–17.
30- Idemudia J, Ugwuja E. Plasma lipid profiles in hypertensive Nigerians. Int J Cardiovasc Res 2008; 6: 1–6.
31- Prabhanjan K, Moges B, Yohannes A, et al. A study of lipid profiles in hypertensive patients visiting Dilla University Referral Hospital. Int J Sci Res 2014; 3: 2336–2338.
32- Osuji C, Omejua E, Onwubuya E, et al. Serum lipid profile of newly diagnosed hypertensive patients in Nnewi, South-East Nigeria. Int J Hypertens 2012; 2012: 710486.
33- Tilvis RS, Valvanne JN, Strandberg TE, et al. Prognostic significance of serum cholesterol, lathosterol, and sitosterol in old age; a 17-year population study. Ann Med 2011; 43: 292–301.
34- Bertolotti M, Mussi C, Pellegrini E, et al. Age-associated alterations in cholesterol homeostasis: evidence from a cross-sectional study in a Northern Italy population. Clin Interv Aging 2014; 9: 425–432.
35- Wen W, Luo R, Tang X, et al. Age-related progression of arterial stiffness and its elevated positive association with blood pressure in healthy people. Atherosclerosis 2015; 238: 147–152.
36- Ferreira I, van de Laar RJ, Prins M, et al. Carotid stiffness in young adults: a life-course analysis of its early determinants: the Amsterdam Growth and Health Longitudinal Study. Hypertension 2012; 59: 54–61.
37- Alghatrif M, Strait B, Morrell C, et al. Longitudinal trajectories of arterial stiffness and the role of blood pressure: the Baltimore Longitudinal Study of Aging. Hypertension 2013; 62: 934–94146
38- Oparil S, Zaman MA, Calhoun DA. Pathogenesis of hypertension. Ann Intern Med 2003; 139: 761–776.
39- Jung CH, Jung SH, Lee B, et al. Relationship among age, insulin resistance, and blood pressure. J Am Soc Hypertens 2017; 11: 359–365.e2.
40- Zavaroni I, Ardigo D, Rossi PC, et al. Relationship between plasma nitric oxide concentration and insulin resistance in essential hypertension. Am J Hypertens 2004; 17: 549–552.
41- Mammas I, Bertsias G, Linardakis L, et al. Cigarette smoking, alcohol consumption, and serum lipid profile among medical students in Greece. Eur J Public Health 2003; 13: 278–282.
42- Saha MS, Sana NK, Shaha RK. Serum lipid profile of hypertensive patients in the northern region of Bangladesh. J Bio-Sci. 2006;14:93–98.
43- Schoolwerth A, Engelgau MM, Hostetter TH, Rufo KH, Chianchiano D, McClellan WM, et al. Chronic kidney disease: A public health problem that needs a public health action plan. PCD. 2006;3(2):1–6.
44- Mittal A, Sathian B, Kumar A, Chandrasekharan N, Sunka A. Diabetes mellitus as a potential risk factor for renal disease among napalese: A hospital based case control study. NJE. 2010;1(1):22–25.
45- Raghupathy A, Kannuri NK, Pant H, Khan H, Oscar HF, Emanuele DA, et al. Hypertension in India: A systematic review and meta-analysis of prevalence, awareness, and control of hypertension. J. Hypertensive. 2014;32(6):1170–77.
46- Coresh J, Wei GL, McQuillan G, Brancati FL, Levey AS, Jones C, et al. Prevalence of high blood pressure and elevated serum creatinine level in the United States. Arch Intern Med. 2001;161:1207–16.
47- Schillaci Giuseppe, Reboldi Gianpaolo, Verdecchia P. High-normal serum creatinine concentration is a predictor of cardiovascular risk in essential hypertension. Arch Intern Med. 2001;161:886–91.
48- Understanding blood pressure readings. American Heart Association. https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings. Accessed July 18, 2022.

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Arabic Abstract

ارتفاع ضغط الدم هو مرض شائع يمكن أن يكون خطيرًا إذا ترك دون علاج .كما أن العديد من العوامل يمكن أن تسبب ارتفاع ضغط الدم، بما في ذلك ارتفاع نسبة الدهون .هناك علاقة قوية بين ارتفاع ضغط الدم وضعف الكلى، وذلك لأن ارتفاع ضغط الدم غير المنضبط هو سبب رئيسي لأمراض الكلى المزمنة .شملت هذه الدراسة 50مريضا يعانون من ارتفاع ضغط الدم و 40فردا من مجموعة السيطرة الصحية .شارك في هذه الدراسة 50مريضا يعانون من ارتفاع ضغط الدم، 28ذكرا و 22 أنثى، تتراوح أعمارهم بين 40إلى 70عاما .وتمت مقارنتهم مع المجموعة السليمة .تم قياس العوامل في هذه المجموعات وهي الكولسترول والدهون الثلاثية و LDL)، HDL، (VLDLواليوريا والكرياتينين .وأظهرت نتيجة هذه الدراسة وجود فرق كبير عند مقارنتها ببيانات المرضى الذين يعانون من ارتفاع ضغط الدم مع مجموعة الأشخاص الأصحاء .نلاحظ أن معظم التحاليل كانت أعلى من الحد الطبيعي والتي شملت الكولسترول والدهون الثلاثية و (LDL,HDL,VLDL)واليوريا والكرياتينين لدى مرضى ارتفاع ضغط الدم .كانت قيمة Pفي .(0.0001) ≥

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The Medical Importance of Snails " A review"

Israa N. Ghulam[1]

[1] *Department of biology / College of Education for Pure Sciences / University of Karbala*

P A P E R I N F O

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A B S T R A C T

This research article provides a comprehensive review of the medical importance of snails from a medical standpoint, whether negative or positive on humans and animals, and whether their effect is direct or indirect. The medical importance of snails in general is in two ways: either as a carrier of disease or as a source of therapeutic agents. There are many aquatic snails that are considered intermediate hosts for parasitic flatworms. Some of them contribute to the spread of schistosomiasis, for example, and it causes great concern for public health. This disease may lead to chronic disease and can lead to severe damage to some organs of the body. Some marine snails, such as cone snails, produce conotoxins. This toxin is a biologically active compound with pharmaceutical potential. It is a powerful neurotoxin that is being studied for its analgesic properties and the possibility of using it as new painkillers. The study of snail biology and their interactions with parasites and bioactive substances offers promising approaches to combating diseases and developing new medical treatments. This study was supported by pictures and diagrams of the life cycle of some snails to clarify some concepts.

1. INTRODUCTION

Snails have attracted the attention of researchers in the field of pathology, especially aquatic snails. Snails represent a diverse group of molluscs that live in various terrestrial and aquatic environments, both salty and fresh, around the world. They play important ecological roles and this comes thanks to their different and diverse environmental adaptations in addition to the roles and stages of their life [1-3]. In this introduction, we see a general overview of the importance of medical snails and their direct or indirect impact on the environment, public health, and pathology. They play an important role in transmitting some transmissible and endemic diseases between humans and animals, as they are secondary hosts for many types of parasites that cause us many diseases, such as schistosomiasis and *fasciola*. There are many different helminth diseases in which these parasites urgently need these snails as a secondary or tertiary host to complete a stage of their life cycle in order to spread the disease to others. Here, we must know the importance of these snails as a secondary or intermediate host, which is essential for understanding the dynamics of parasitic diseases in systems. On the one hand, they contribute to combating diseases by maintaining the delicate balance of this ecosystem, in addition to their contribution to consuming and breaking down organic materials and thus contributing to the decomposition process and releasing essential nutrients back into the water, thus feeding aquatic plants and supporting the food chain, other than snails and the extent of their contribution. Accumulation of organic materials can occur, leading to imbalances such as excessive growth of some organisms and not others, which leads to an increase and environmental imbalance that gives us an increase in the number of microbes and viruses and an attempt to violate the laws of the selective systems of nature, thus increasing epidemics, diseases, and health problems for the individual and society [4,6,7,44,45]. On the other hand, the mission of snails contributes to treating many diseases and injuries, such as burns and treating the effects of skin inflammation and acne. They contribute to clearing and purifying the skin and the skin through their secretion of the mucous substance that snails use to skate on. It represents the way snails move, especially terrestrial snails, and it is secreted in abundance in some types, such as snails. African because this substance is mucous and a chemical composition composed of compounds that are of great benefit to the skin and treat

*Corresponding Author Institutional Email: esraa.naser@uokerbala.edu.iq (Israa N. Ghulam)

it from pigmentation and dead cells, and this is what you find popular in tourist [47-49].

There is a family of Conidae (cone snails), which are marine snails that produce a toxic compound that contains conotoxins, which are complex peptides that have strong and specific effects on the nervous system.

Specifically, ion channels. Research in the field of conotoxins has led to the development of a new type of analgesic such as ziconotide, which is used to treat severe pain in some patients with chronic pain who do not respond to pain medications [65].

Thus, understanding the medical importance of snails includes prevention and treatment of some discovered diseases, and continuing research generates the innovation of new treatments and clear mechanisms in understanding the medical field of snails.

2. MATERIALS AND METHODS,

Most work methods begin by collecting snails according to their terrestrial or aquatic environment, using multiple methods such as manual collection, scanning net, or catching them. These snails are then diagnosed and classified according to their taxonomic characteristics using taxonomic keys. Sometimes molecular techniques are used to determine the types of snails if this is difficult. Then, Examining the snail or dissecting it and using different techniques to detect the presence of larvae or parasitic eggs, such as sedimentation and filtration, or using PCR techniques or some serological and immunological studies to diagnose snails (ELISA), or sometimes it does not require dissecting it, but simply collecting samples of the mucus it secretes to take it. Samples for the purpose of making smears to develop a bacterial culture or to reveal the chemical description of the mucus, how many compounds, and analyze them for their components, or to use methods to extract a specific compound or substance that has an effect or effectiveness, and this is done through biochemical tests and methods [7,8,9,10,11,12,47,48,49].

Most of the diseases that snails contribute to in completing their life cycle as an intermediary and thus contribute to the spread of diseases and epidemics are dioecious parasites with hosts. This process begins as soon as the eggs leave the body of the final host, passing through the intermediate host until the parasite's morphological transformation and the departure of the intermediary. This is what is shown through the life cycle of one of the parasites that It needs a shell to complete its life cycle [12,13].

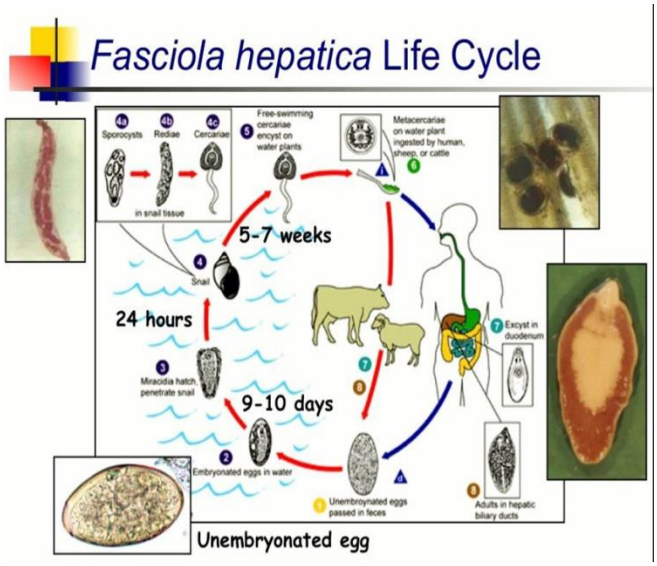

Figure 1. A picture of the life cycle of Fasciola hepatica that need intermediated hosts [13]

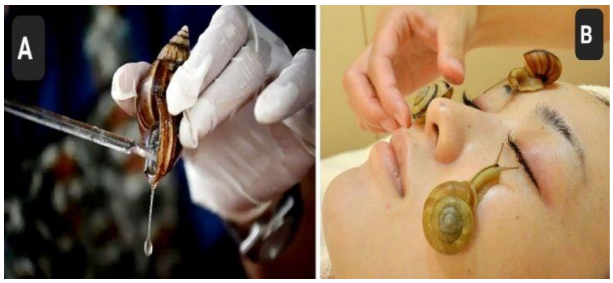

Figure 2. A shows the mucus secreted by the snail, B represents how the snail is used to clean the skin and crawl over the face [50,51]

Here we mention the most important research that is concerned with explaining the medical importance of snails as a mediator or as a direct influence. The research results of this article reached a number of types of snails studied in various medical fields, which are as follows:

Very extensive studies have talked about types of snails as an intermediate host for many parasitic diseases and the importance of the role of the secondary host in completing the parasite's life cycle. There were many types of snails, including:

- Important intermediate hosts of the parasitic schistosomiasis, an important disease and global public health concern e.g. Biomphalaria snails [7,17,18,31,32,33,38,42,45] , As an intermediate host for many trematodes, such as *Fasciola hepatica*, Hypodermic cysts and *Echinostoma spp*. Studies have shown an increase in infection rates with this type of parasite, which includes snails of this category, and this indicates its role as an important intermediate host, as in

Planorbidae snails [30,36,37, 40,41] , as an intermediate host for *Fasciola hepatica*, a worm that causes fascioliasis in humans and livestock. Most studies talk about the susceptibility of *Lymnaea* groups to infection with Fasciola hepatica. The majority of studies also talk about the genetic diversity of the same group, the genetic strains of snails as in the group Lymnaeidae snails [15,17,37,40,44] , As an intermediate host for various trematodes that infect fish, it has an indirect impact on public health and ecosystems, and its examples are many, as in Physidae snails, such as *Physa acuta*, *Echinoparyphium spp*. and *Diplostomum spp. Diplostomum spp*. [17,19,20, 256 ,30, 33,42] And also Melanopsidae snails [14,20, 25,33] And another group Valvatidae snails *Valvata spp*. such as *Echinoparyphium spp* [,23,26] , Thiaridae snails like *Centrocestus spp.* and *Echinostoma spp* [24,25] , Ampullariidae snails includes snails like *Pomacea spp*. and Marisa spp. [28,29,47[

- The second part of the research includes studies on the mucous secretions of various snails, especially terrestrial ones. Either it is included in a specific drug to treat and clear the skin, or the use of mucus by adding other substances to aid in bacterial treatment, or survey studies on the mucous secretions of a specific snail for the purpose of knowing its efficiency in inhibiting the action of certain bacteria [52,53,54,55, 56,57,58,59, 60,61, 62,63].

3. CONCLUSIONS

Snails play an essential role in the medical field and transmit diseases or help spread or infect them. This comes through what snails play in the life cycle of various parasites, as they facilitate their growth and complete reproduction, and without them, the parasite cannot cause infection and spread the epidemic. It has also been found that snails contribute to the treatment of some disease conditions and infections spread in the skin with the help of their mucous secretions. Snails are of high nutritional value through the minerals and vitamins they contain, which contribute to strengthening the individual's immunity, especially marine ones, and the damage these organisms cause is not far from the medical field. In environmental systems, especially aquatic systems, to increase bacterial and environmental pollution and thus increase and localize transmissible diseases.

4. REFERENCES

1. Dillon, R. T. Jr. (2000). The Ecology of Freshwater Molluscs. Cambridge University Press.
2. Glöer, P. (2002). Die Süßwasser gastropoden Nord- und Mitteleuropas. Die Tierwelt Deutschlands. ConchBooks.
3. Barnes, R. D. (1987). Invertebrate Zoology. Holt-Saunders International.
4. Hughes, D. P. (2013). Pathways to parasite evolution in a complex world. Current Opinion in Microbiology, 16(4), 490-496.
5. Trapella C, Rizzo R, Gallo S,(2018) .Helix Complex snail mucus exhibits prosurvival, proliferative and pro-migration effects on mammalian fibroblasts. Sci Rep. 2018;8(1):1-10. https://doi.org/10.1038/s41598-018-35816-3
6. Burch, J. B. (1989). North American Freshwater Snails. Malacological Publications.
7. Standley, C. J., & Stothard, J. R. (2012). The detection of species and genotypes within medically important nematodes (order Strongylida) and trematodes (family Schistosomatidae) using a DNA-based toolbox. Molecular and Cellular Probes, 26(1), 1-13.
8. Attwood, S. W., Fatih, F. A., Mondal, M. M., Alim, M. A., Friis, H., & Christensen, N. O. (2006). A practical laboratory-based system for monitoring the viability of Schistosoma japonicum cercariae. Journal of Parasitology, 92(3), 465-468.
9. Said, D. E., El-Fakahany, A. F., & Ahmed, A. A. (2007). Identification of medically important snails in Egypt and the possible role of some in transmission of some trematodes. Journal of the Egyptian Society of Parasitology, 37(2), 511-524.
10. Sokolova, E., Bensch, S., & Mouritsen, K. N. (2012). PCR-based detection of larval trematodes in the snail intermediate host and bird definitive host. Molecular Ecology Resources, 12(5), 832-842.
11. Duval, D., Galinier, R., Mouahid, G., Toulza, E., Allienne, J. F., Portela, J., & Boissier, J. (2009). A shift from cellular to humoral responses contributes to innate immune memory in the vector snail Biomphalaria glabrata. PLoS Pathogens, 5(3).
12. Constantine, C. C., Stothard, J. R., & Rollinson, D. (2001). Advances in the control of snail-borne disease using molecular diagnostics. Transfusion Medicine, 11(4), 331-337.
13. World Health Organization (WHO). (2020). Key facts. [Online]. https://st.simplehealth.ltd/uAJjyu
14. Ghulam, I.N. (2015). Ecological, Biological and Histological study of the freshwater snails infected with digenean larvae. PHD thesis. Karbala university.
15. Al-Waeli , A. B. (2014). Use of molecular technique and scanning electron microscope in freshwater snails taxonomy and their infection with larval trematoda in the middle and south of Iraq. PhD thesis . Al-Qadisiyah University .
16. Ghulam, I. and Magid, G. (2016). Study of fertility and development stages of freshwater snail Physa acuta Draparnaud, 1805 (Mollusca: Gastropoda) in Al- Hussainia channel/ The holy Karkala,14(3): 106-113.
17. Gryseels, B. (2012). Schistosomiasis. Infectious Disease Clinics of North America, 26(2), 383-397.
18. Colley, D. G., Bustinduy, A. L., Secor, W. E., & King, C. H. (2014). Human schistosomiasis. The Lancet, 383(9936), 2253-2264
19. Mandahl-Barth, (1989) Studies on African freshwater bivalves. Danish Bilharziasis Laboratory, Charlottenlund. 161 pp.
20. Hotez, P. J., Bottazzi, M. E., Franco-Paredes, C., Ault, S. K., & Periago, M. R. (2008). The neglected tropical diseases of Latin America and the Caribbean: A review of disease burden and distribution and a roadmap for control and elimination. PLoS Neglected Tropical Diseases, 2(9).

21. Yoshida, A., Nakayama, T., & Sako, Y. (2018). Zoonotic helminth infections with particular emphasis on fasciolosis and other trematodiases. Japanese Journal of Infectious Diseases, 71(1), 19-27.
22. Ichikawa-Seki, M., Shiroma, Y., Tokashiki, M., & Itokazu, K. (2015). Prevalence and genetic diversity of zoonotic helminths in pet dogs and cats in the subtropical islands of Okinawa, Japan. Veterinary Parasitology, 212(3-4), 393-397.
23. World Health Organization. (2011). Foodborne trematode infections in Asia. Geneva: World Health Organization Available .
24. Brown, R. A. (1994). Freshwater snails of Africa and their medical importance. CRC Press.
25. Dillon, R. T., & Wethington, A. R. (2004). Multiple paternity and female sperm storage in a natural population of a freshwater snail, Potamopyrgus antipodarum. Evolutionary Ecology Research, 6(2), 261-275.
26. Farahnak, A., Bakhtiyari, M., & Habibpour, B. (2016). Freshwater snails as intermediate hosts for trematodes in Iran: A systematic review. Iranian Journal of Parasitology, 11(4), 427-442.
27. Kane, R. A. (2016). Biology and Ecology of Venomous Marine Snails. CRC Press.
28. Kumar, R., & Singh, N. K. (2009). Freshwater molluscan fauna (Gastropoda: Pelecypoda) of India: State of the art. Zoological Survey of India.
29. Loker, E. S. (1983). A comparative study of the life-histories of mammalian schistosomes. Parasitology, 86(2), 209-224.
30. Morand, S., & Krasnov, B. R. (2010). The Biogeography of Host-Parasite Interactions. Oxford University Press.
31. Nunes, A. L., & Loker, E. S. (2013). Spreading the net: The multiple roles of cercariae in the life cycle of trematode parasites. PLoS Pathogens, 9(6), e1003567.
32. Pointier, J. P., & Jourdane, J. (2000). Biological control of the snail hosts of schistosomiasis in areas of low transmission: The example of the Caribbean area. Acta Tropica, 77(1), 53-60.
33. Richards, C. S. (2019). An update on the distribution and diversity of freshwater gastropods of Texas and the southern United States. Texas A&M University Press.
34. Sokolow, S. H., Wood, C. L., Jones, I. J., Swartz, S. J., Lopez, M., Hsieh, M. H., ... & Lafferty, K. D. (2016). Global assessment of schistosomiasis control over the past century shows targeting the snail intermediate host works best. PLoS Neglected Tropical Diseases, 10(7), e0004794.
35. Toledo, R., & Fried, B. (2005). Biomphalaria snails and larval trematodes. Experimental Parasitology, 110(4), 283-293.
36. Farahnak, A., Bakhtiyari, M., & Habibpour, B. (2016). Freshwater snails as intermediate hosts for trematodes in Iran: A systematic review. Iranian Journal of Parasitology, 11(4), 427-442.
37. Fried, B., & Toledo, R. (2016). The Biology of Echinostomes: From the Molecule to the Community. Springer.
38. Haas, W. (2003). Parasitic worms: The pathology of parasites. Parasitology Research Monographs, 1, 1-240.
39. Huspeni, T. C., & Lafferty, K. D. (2004). Using larval trematodes that parasitize snails to evaluate a saltmarsh restoration project. Ecological Applications, 14(3), 795-804.
40. Hughes, D. P., Thomas, F., & Boomsma, J. J. (2010). Host manipulation by parasites: A look back before moving forward. Evolutionary Ecology, 24(6), 1201-1215.
41. Poulin, R. (2010). Parasite manipulation of host behavior: An update and frequently asked questions. Advances in the Study of Behavior, 41, 151-186.
42. Lafferty, K. D. (1999). The evolution of trophic transmission. Parasitology Today, 15(3), 111-115.
43. Thomas, F., Adamo, S., & Moore, J. (2005). Parasitic manipulation: Where are we and where should we go? Behavioral and Brain Sciences, 28(4), 571-588.
44. Poulin, R., & Maure, F. (2015). Host manipulation by parasites: A multidimensional phenomenon. Oikos, 124(9), 1099-1106.
45. Poulin, R. (2016). Parasite manipulation of host behavior: An update and appraisal. Parasite, 23, 38.pp.
46. Thomas, F., Fauchier, J., & Lafferty, K. D. (2002). Conflict of interest between a nematode and a trematode in an amphipod host: Test of the "sabotage" hypothesis. Evolutionary Ecology Research, 4(5), 657-667.
47. Nur Saadah Daud, Achnis Jum Akbar, Eny Nurhikma, & Karmilah (2018). Formulation of snail slime (Achatina fulica) anti-acne emulgel using tween 80-SPAN 80 as emulsyving and HPMC as gelling agent. Borneo Journal of Pharmacy, Volume 1 Issue 2, November 2018, Page 64 – 67.
48. Garg, A., Aggrawal, D., Garg, S., Singla, A.K. (2002).Spreading of Semisolid Formulations: An Update. Pharmaceutical Technology. pp 84-105.
49. Aghina, Y., Amila, G. dan Dina, M. (2015). Formulasi Masker Gel Pell Off Lendir Bekicot (Achatina fulica) dengan Variasi Konsentrasi Bahan Pembentuk Gel. Prosiding Penelitian Spesia UNISBA Farmasi Gelombang 2, Bandung, pp 246.
50. "Snail facials" use slime for anti-aging skin care https://www.cbsnews.com/news/snail-facials-use-slime-for-anti-aging-skin-care.
51. hai farmers on the cash trail with snail slime . https://phys.org/news/2019-07-thai-farmers-cash-trail-snail.amp
52. Agu M. O., Tsware B. J., Sunday A. O., Onwuka J. C., Anthony H. J. (2018). An investigative study of long-term dosing of costus aureus, snail mucus, and its combination with a standard pharmaceutical drug on blood glucose level in alloxan-induced Swiss albino rats. Open G-Med. Chemistry. 08, 1-14. 10.4236/ojmc.2018.81001 .
53. Anand B., Filippenco B., Huaman J., Leudmer M., Hussein M., Santamaria C., et al. (2019). Selective inhibition of hepatocellular carcinoma cells using a toxin peptide. Drugs 17 (10), 587. 10.3390/md17100587 [PMC free article.
54. Balabushevich N., Sholina E., Mikhalchik E., Filatova L., Vikulina A., Volodkin D. (2018). Mucin-containing microcarriers self-assembled via solid templates on CaCO3 crystals. Micromachines 9, 307.10.3390/mi9060307.
55. Bancel, R., & Turner, B. S. (2006). Myosin structure, aggregation, physiological functions and biomedical applications. the currency. opinion. Colloid interference. Sci-fi. 11, 164-170. 10.1016/j.cocis.2005.11.001 .
56. Benktander J, Venkatakrishnan F, Bhadra JT, Sundh H, Sundel K, Murugan AM, et al. (2019). Effects of size and geographic origin on Atlantic salmon, Salmo salar, Mucin O-Glycan repertoire. mall. Cell Proteomics 18, 1183-1196. 10.1074/mcp.ra119.001319 [PMC free article] .

57. Bhatt b. (1995). Limited role of mucus in drug absorption: drug penetration through mucus solution. Int. Y. Pharmaceuticals 126, 179-187. 10.1016/0378-5173(95)04120-6 .
58. Bornhöfft K. F., Goldammer T., Rebl A., Galuska S. P. (2018). Siglecs: a journey through the evolution of sialic acid-binding immunoglobulin-type lectins. Develop. Companies. Immunol. 86, 219-231. 10.1016/j.dci.2018.05.008 [PubMed] .
59. Çelebioglu, H. Y., Li, S., & Kronakis, I. S. (2020). Interactions of salivary mucins and saliva with food proteins: a review. Critical. Rev. Food Science. Notre. 60, 64-83. 10.1080/10408398.2018.1512950.
60. Chen, X., Li, J. S., Zettel, A., & Bertozzi, C. R. (2004). Biomimetic engineering of carbon nanotubes using cell surface mucin mimetics. Survive. Chemistry. Int. Mr. Dr. 43, 6111-6116. 10.1002/anie.200460620 [PubMed].
61. Coherent Market Insights (2018). Analysis of the global snail beauty products market. March 23, 2018. [Online]. Available at: https://wwwcoherentmarketinsights.com/press-release/global-snail-beauty-products-market-to-surpass-us-7695-million-by-2025-754 (accessed 04 February 2021).
62. Gerdol M. (2017). Immune-related genes in gastropods and bivalves: a comparative overview. Invertebrates. Survival. Part 14, 103-118.
63. Gould, J., Valdez, J. W., Upton, R. (2019). The sticky, defenseless mucous secretions of the red triangle bullfrog (Triboniophorus Graeffei) can incapacitate adult frogs. Ethics 125, 587-591. 10.1111/eth.12875 .
64. Gugu T. H., Onwusoba R. C., Onyi P. N., Ozioko A. C. (2020). Synergistic interaction of natural snail mucin and lincomycin for chemoimmunotherapy against pneumococcal infection: checkerboard evaluations. Int. JPharm. invest. 10, 379-383. 10.5530/ijpi.2020.3.67.
65. Terlao, H., & Oliveira, P. M. (2004). Cone toxins: a rich source of novel ion channel-targeting peptides. *Physiological Reviews, 84*(1), 41-68.

Arabic Abstract

يعرض هذا المقال مراجعة شاملة الأهمية الطبية للقواقع ، سواء كانت سلبية أو إيجابية على الإنسان والحيوان، وما اذا تأثيرها مباشر أو غير مباشر. وجاءت الأهمية الطبية للقواقع بشكل عام في ناحيتين: إما باعتبارها ناقلة للمرض أو كمصدر للعوامل العلاجية. هناك العديد من القواقع المائية التي تعتبر مضيفًا ثانويا للديدان المسطحة الطفيلية. فبعضها يساهم في انتشار مرض البلهارسيا مما يسبب قلقا كبيرا على الصحة العامة. وقد يؤدي هذا المرض إلى الإصابة بمرض مزمن ويمكن أن يؤدي إلى أضرار جسيمة في بعض أعضاء الجسم.او تنتج بعض القواقع البحرية، مثل القواقع المخروطية، سمومًا كونوتوكسينية. هذا السم هو مركب نشط بيولوجيًا وله إمكانات صيدلانية. وهو سم عصبي قوي تتم دراسته لخصائصه المسكنة وإمكانية استخدامه كمسكنات جديدة للألم. تقدم دراسة بيولوجيا الحلزون وتفاعلاتها مع الطفيليات والمواد النشطة بيولوجيا أساليب واعدة لمكافحة الأمراض وتطوير علاجات طبية جديدة. وقد تم دعم هذه الدراسة بالصور والرسوم البيانية لدورة حياة بعض القواقع لتوضيح بعض المفاهيم.

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Separation Heavy Metals from Waste Water

Bedour Ali Mohammed[1] , Rawaa Alattar[2], Dhiea M Al – Alnessrioy[3*], Ali R. Khudhair[4]

[1,2] Department of Chemistry, College of Science, University of Kerbala, Karbala, Iraq
[3,4] Department of Chemistry, College of Education for Pure Sciences, University of Kerbala, Karbala, Iraq

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A B S T R A C T

The aim of the study of wastewater treatment is to reduce the amount of pollutants in the waterways. Certain countries use biological filtration techniques, while others resort to sedimentation or filtration. Several factors have reduced harmful emissions, including technological advancements and a shift towards less mineral production. However, with the increasing consumption of heavy metals, it is of utmost importance to vigilantly monitor the concentration of these contaminants. Mass spectrometry and atomic absorption spectroscopy are utilized to analyze the various elements in wastewater. These analytical tools are vital in this process and are highly regarded in scientific studies.

1. INTRODUCTION

Humans and other aquatic life rely on water for survival. However, water availability has decreased due to the increased human activities and the need for more resources. Large-scale sewage discharges can threaten industrial facilities [1]. Those producing heavy metals, like those found inside industrial facilities, tend to absorb heavy metals, which can then accumulate in various parts of the body [2]. These are originated from the Earth's crust. While heavy metals are often considered non-toxic, their cumulative effects can be detrimental to human health. For instance, exposure to zinc, copper, and selenium can lead to severe poisoning. Realizing the factors that impact human health is crucial to preventing heavy metals from infiltrating our water supply and posing a threat to individuals [3]. The two types of heavy metals are essential and non-negotiable. The former refers to substances living organisms that must be utilized to perform certain functions. The latter, on the other hand, includes elements such as zinc, copper, and Fe. In contrast, non-essential metals such as those that are found in Al, Pb, Zn, Cu, Cr, and Hg are not required in metabolic processes [4]. Table 1 shows a comparison of properties of the heavy metal with light metal [5,6].

TABLE 1. Properties compared heavy and light metals.

Chemical and physical properties	Light metal	Heavy metal
Density	Usually lower	Usually higher
Melting point	Mostly low	Mostly to very high
Periodic table location	Most were found in groups 1 and 2	Nearly all found in groups 3 through 16
Reactivity	More reactive	Less reactive
Complex	Colourless	Colored

1.1 Classification of heavy metals

Heavy metals are classified into two types: non-essential and essential. The former includes elements of living organism which are required to perform certain functions, such as growth and metabolism. Essential ones, such as copper, zinc, and iron, are commonly required in trace amounts. On the other hand, non-essential elements like aluminum, manganese, and PB are not essential in metabolic processes [7,8].

1.2 Sources of heavy metals in aquatic environment

Heavy metals are transported to various bodies of water, especially freshwater, which is the primary medium for the largely rural and urban environment circles that develop. Pollution can occur in different ways due to human activities and natural sources [9].

1.2.1 Natural resources

Various geological processes, such as erosion and rock formations, release heavy elements into the aquatic environment through the ground or the air, transporting these minerals to the region [10].

*Corresponding Author Institutional Email: diea.m@uokerbala.edu.iq (Dhiea M Al–Alnessrioy)

1.2.2 Human resources

Industrial activity is a significant source of pollution with heavy metals in the environment. They are sources of metal pollution, including the petroleum industries, oil refineries, iron and steel factories, copper, glass, aluminum, tanning factories, fertilizers, pesticides, gasoline, and others [11].

1.3 Forms of heavy elements in the aquatic environment

There are three forms of heavy metals in water:

1- Dissolved heavy metal: this is represented by the elements present in the aqueous phase that passes through a filter paper whose openings are (45.0um) when filtering the water sample [12].

2. Particulate heavy metals

They include the elements present with suspended materials inside the components of the water, which cannot pass through filter papers whose openings are (45.0um) when filtering the water sample [13].

3. Heavy metals in bottom sediments:

Including:

- ❖ Exchangeable metals: these comprise elements that do not fall within the silica or reticular structure of sediment but are absorbed on the surfaces of benthic sediment particles [14].
- ❖ Residual metals: they are elements that fall within the silica or reticular structures of the benthic sediments [15].

1.4 Method of remove heavy metals in aquatic environment

The existence of heavy metals in wastewater increases with the growth of industry and human activities, such as the paint and electroplating industry, batteries, pesticides, mining industry, rayon industry, metal rinses, tanning industry, fluidized bed bioreactors, textile industry, metallurgy, smelting applications, petrochemicals, paper manufacturing, and electrolysis. Wastewater contaminated with heavy metals finds its way into the environment, menacing human health and the ecosystem. Heavy metals are not biodegradable. Besides, they can be carcinogenic. Thus, these minerals in inappropriate quantities in the water can lead to thoughtful health problems for living organisms. The greatest common heavy metals are lead (Pb), zinc (Zn), mercury (Hg), nickel (Ni), cadmium (cadmium, copper (Cu), chromium (Cr), and arsenic (As), but we can find other metals in wastewater such as silver (Ag), iron (Fe), manganese (Mn), molybdenum (Mo), boron (B), calcium (Ca), antimony (Sb), cobalt (Co), etc. These metals must be removed, and here we review recent developments and different methods for removing heavy metals from wastewater. The researchers also evaluate the advantages and limitations of applying these techniques. There are many methods for removing minerals in wastewater. These methods can be categorized into adsorption-, membrane, chemical, electrolysis, and photocatalysis-based treatments. Nevertheless, particular emphasis is placed on the processes of innovative removal, including adsorption on anaerobic adsorbents, biosorption, and photocatalysis. These processes have led to new directions and attracted more and more research in eliminating heavy metals from wastewater due to their high efficiency, versatility, and availability in large quantities. Applicability, wastewater characteristics, cost-effectiveness, and plant simplicity are the main factors in choosing the most appropriate method for contaminated wastewater [16-21].

1.5 Adsorption -based separation

Adsorption is the process of deposition of molecular organisms on a surface. The molecular species that are adsorbed are referred to as adsorbate, while the surface where they occur is called an adsorbent. Some of the frequently used adsorbents include silica gel, clay, and colloids. [22]. The mechanism for adsorbing heavy metals is determined by the various properties of the materials used, such as their chemical and physical properties. The initial concentration of the metal ions, operating conditions, and pH value are also considered to determine the effectiveness of this method. This method can be utilized to remove heavy metal ions from the surface of a sorbent. It has low operating costs and easy processing. [23]. Adsorption process for heavy metal ions: the metal ions of wastewater adhere to the surface of nanoporous adsorbents, which have a high surface area due to their porosity. The adsorption process could be selective for one or more metals than others. The regeneration process could be achieved using a desorbing agent as shown in Figure 1 [24].

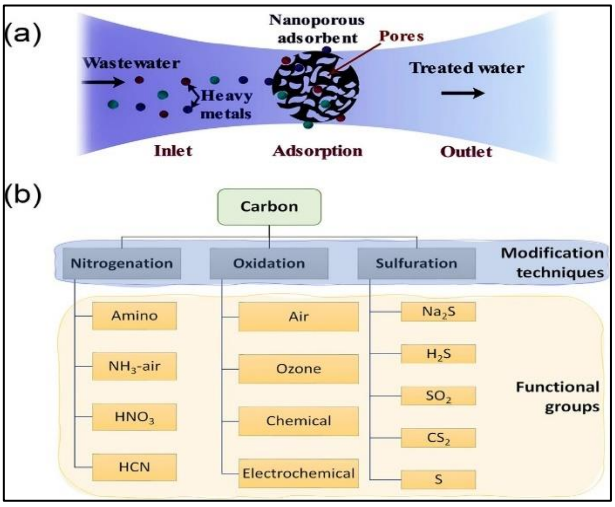

Figure 1. The regeneration process [25].

1.6 Toxic Effects of Heavy Metals

There is no widely agreed definition, so it can be defined based on density or the basis of atomic weight. Definitions based on atomic weight have been criticized because they cover elements with low-density [26]. Several health organizations are currently studying the effects of heavy metals such as Vanadium, Titanium, Gallium, Chromium, Cobalt, Iron, and Copper, which have a density of over 5. They are also interested in studying the effects of other critical minerals like Gold, Tin, Lead, and Mercury [27]. A silvery-white metal known as nickel is a constituent of the transition metals. It exhibits various characteristics, such as a malleable and ductile structure. It is also commonly used in the manufacture of batteries and electroplating. Due to its electrical conductivity, nickel is regarded as an ideal conductor. It is toxic, and it must be handled with care [28]. Cadmium is toxic and it threatens the environment. It can also cause various health conditions like kidney damage and respiratory failure. Although it is known to be present at low environmental levels, human activity increases its levels [29]. See Table 2.

TABLE 2. The elements average in ppm and location.

Elements average (ppm)						Location
Zn	**Fe**	**Cu**	**Mn**	**Cd**	**Pb**	**Elements**
0.302	4.947	0.094	0.285	0.005	0.007	Crude(C)
3.095	3.713	0.085	0.903	0.002	0.005	Pre.Aeration(P.A)
0.139	2.140	0.115	0.215	0.004	0.005	Prim.setting(PS)
0.06	0.307	0.098	0.116	0.003	0.003	Final(F)
0.040	0.455	0.115	0.120	0.004	0.008	After chlorination(Cl_2)
0.727	2.312	0.101	0.327	0.0036	0.0053	General Average

2. METHOD

Water purification center to learn how to remove various impurities and minerals from the water. The water supply came from multiple sources, such as streams, lakes, and rivers. The first step in the purification process is to enter a sedimentation chamber with multiple funnels designed to separate the contaminants from the water. Alum, a key component in the water purification process, plays a significant role when the concentration of impurities or mud exceeds a certain level, typically 40% or 30%. It attracts minerals and breaks them apart into a gel substance [30,31], thereby facilitating their removal. However, when the percentages are low, the filters and sedimentation process alone can effectively remove contaminants, making alum unnecessary. After the initial purification steps, the water is collected in metal basins. The accuracy of this technique is its main advantage. The sedimentation process. To initiate the process, mixers are used to move the water [32], and a perforated tube is employed to remove the water from the top surface. The impurities, now separated from the water, are transferred to the collection basins, ensuring the cleanliness and safety of water for human use. Following the sedimentation process [33], the water is sent to the purification stage using filters, which can help remove unwanted elements and impurities. The water is then transferred to the filters through tubes [34,35]. Each filter features a set of legs spread throughout the basin, and its shape is a large basin below it. The filters help remove various elements and impurities from the water. After stopping work at night, the filters are washed. They are ready to work the following day once the water has been pumped from the bottom. Chlorine is then added to water in order to treat the contaminants. This process is carried out using a pressure-dispersion method [36]. The membrane is then removed through this process, and a portion of chlorine is pumped for increasing its sterilization. This process then prepares the product for human use. In long distances, chlorine's concentration decreases, and its aroma sometimes disappears from water [37]. A particular type of basin is made to deal with defective or perforated gas bottles that contain chlorine. This substance can be harmful if ingested or inhaled., and it can cause severe respiratory damage if its concentration exceeds a certain level, Figure 2. [38]

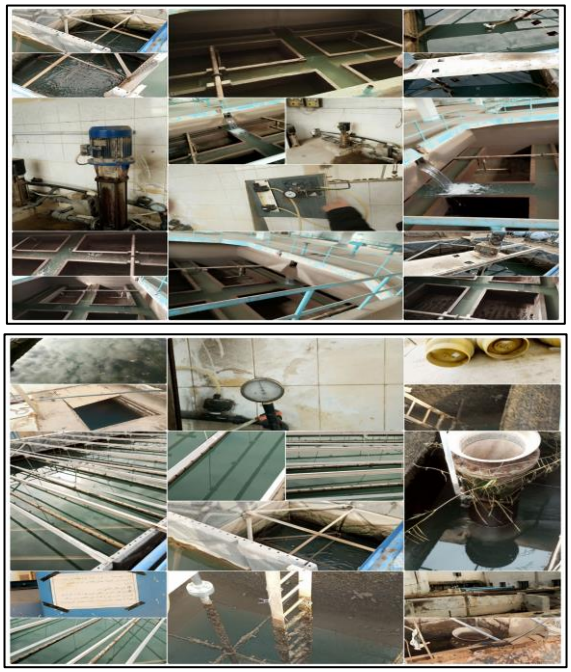

Figure 2. Pictures explains the steps for removing heavy metals from wastewater in the water purification center in Karbala city.

3. RESULTS AND DISCUSSION

The analysis of the samples revealed that the lead concentration in the water samples was over 17 mg/l. In the water that came from the tank and was treated, the concentration was around 08.0 mg/l. This suggests that proper water treatment is essential to minimize the effects of lead exposure. The process of water treatment induced a cadmium concentration fluctuation, highlighting the element's unpredictable nature. For instance, the sample water's 005.0 concentration exceeded the 04.0mg/liter limit. This suggests that the water treatment process must be continuously adjusted and monitored. The process of water treatment reduced the overall rate of change in the samples. For example, the sample water with a level of 005.0mg/l decreased in concentration to 0036.0mg/l during the operation of the Diyala River. The drop in the rate of change demonstrated the efficiency of the the process of water treatment . While the sample water had a lead concentration of 903.0 mg/L, the lowest reading during the tank's final chlorination was 116.0mg/L. Despite the slight decrease in the element's value, the wastewater still had a high concentration. The copper element's overall rate of change was 327.0 mg/l. After reaching 94.0 mg/l during treatment, its concentration increased in the samples from different regions. The changes exhibited after treatment were also higher than those of the source. A conclusion was reached after further analysis of the iron results. That was , a way existed to reduce the element's body parts' concentration. Concentrations in the chloroform and sediment basins decreased after the water treatment process started. Before the treatment started, they were at a high of 947.4 mg/l. The air Aeration and primary sedimentation basins maintained their rates of change. The water supply of the station comes from the nearby district of the Diyala river, which has about half of its body's total elements. The zinc element's value fluctuated with the samples, and before it was treated, it had a value of about 302.0 mg/l. [39- 44].

4. CONCLUSION

The sedimentation process was synthesized for the heavy metals removal from wastewater. It showed an extraordinary adsorption capacity to aqueous heavy metals ions based on the ion exchange reaction. The air Aeration and primary sedimentation basins maintained their rates of change.

5. REFERENCES

1. H. R.Asemaneh, , L.Rajabi, , F.Dabirian, , N.Rostami, A. Ashraf Derakhshan,R.Davarnejad,"Functionalized Graphene Oxide/Polyacrylonitrile Nanofibrous Composite: Pb2+ and Cd2+ Cations Adsorption." Pure Sciences International Journal of Kerbala, Vol. 33, No. 6, , pp.1048-1053, 2020. DOI: 10.5829/ije.2020.33.06c.01.
2. S.Mitra, , A. J.Chakraborty, A. M. Tareq, T. B. Emran, F.Nainu, A.Khusro & J.Simal-Gandara (2022). Impact of heavy metals on the environment and human health: Novel therapeutic insights to counter the toxicity. *Journal of King Saud University-Science*, vol.34, no. 3,pp. 101865,2022.
3. R. H.French, , Open-channel hydraulics. New York: McGraw-Hill, 1985.
4. A.Karbakhsh, , I.Othman, Z. Ibrahim, K.Malek & H.Hashamdar, Variations of Horizontal Stiffness of Laminated Rubber Bearings with Different Boundary Conditions. In *Australian Structural Engineering Conference (2010: Sydney, NSW)*, Sydney, NSW: Engineers Australia, vol.1,no.1,(pp. 1400-1410). 2010.
5. M. M.Kazim& S. A.Kadhum, Physical-Chemical Properties and Spatial Distribution of Heavy Metals in Agriculture Soil in Al-Qadisiyah City by Using ArcGIS and Multivariate Analysis, *Eco. Env. & Cons*, vol.28 ,no.3 , pp. 1-9, 2022
6. O.Sadak, Chemical sensing of heavy metals in water. In *Advanced Sensor Technology* Elsevier, pp. 565-591, 2023
7. R.Karkra, P. Kumar, B. K. Bansod, S.Bagchi, P.Sharma& C. R.Krishna, Classification of heavy metal ions present in multi-frequency multi-electrode potable water data using evolutionary algorithm. *Applied Water Science*, vol.7, pp.3679-3689, 2017.
8. A,Saad, A.El-Sikaily & H.Kassem, Essential, non-essential metals and human health. *Blue Biotechnology Journal*, vol.*3*,no.4, pp.447, 2014.
9. R. K.Gautam, S. K.Sharma, S. Mahiya, & M. C. Chattopadhyaya, Contamination of heavy metals in aquatic media: transport, toxicity and technologies for remediation, 2014.
10. V.Balaram, L.Copia, U. S.Kumar, J.Miller & S.Chidambaram, Pollution of water resources and application of ICP-MS techniques for monitoring and management–A comprehensive review. *Geosystems and Geoenvironment*, 100210, 2023.
11. J.Briffa, E. Sinagra & R. Blundell, Heavy metal pollution in the environment and their toxicological effects on humans. *Heliyon*, vol.6,no. 9, 2020.
12. A.Talal, S. A. Alkinani, A. F.Almansoory & K. F.Abbas,. Some of Heavy Elements in Water, Fish and Plant Species from Shatt Al-Arab at Basrah Governorate–Iraq. *Basrah Journal of Science*, vol.*38*,*no.*1, pp.60-74, 2020
13. S.Kumari, M. K.Jain & Elumalai, S. P. (2021). Assessment of pollution and health risks of heavy metals in particulate matter and road dust along the road network of Dhanbad, India. *Journal of Health Pollution*, *11*(29), 210305.
14. S.Gnanasekaran & S. A.Raj, Heavy Metal Bioaccumulation in Sediment and Benthic Biota. In *Heavy Metals-Recent Advances*. IntechOpen, (2023).
15. K. K.Sodhi, Mishra, , C. K.Singh & M.Kumar, Perspective on the heavy metal pollution and recent remediation strategies. *Current Research in Microbial Sciences*, vol.3, pp.100-166, 2022.
16. I. Y.El-Sherif, S.Tolani, Ofosu, Mohamed, O. A. & Wanekaya, A. K. Polymeric nanofibers for the removal of Cr(III) from tannery waste water. J. Environ. Manag. 129, 410–413 (2013).
17. Y.Zou, et al. Environmental remediation and application of nanoscale zero-valent iron and its composites for the removal of heavy metal ions: a review. Environ. Sci. Technol,vol. 50, pp.7290–7304,2016.
18. G. Tjandraatmadja, et al. Sources of critical contaminants in domestic wastewater: contaminant contribution from household products,2008.
19. M.Taseidifar, F.Makavipour, R. M. Pashley & A. F. M. M.Rahman, Removal of heavy metal ions from water using ion flotation. *Environ. Technol. Innov.* vol.8, pp.182–190 ,2017.

20. W. R. García-Niño & J.Pedraza-Chaverrí, Protective effect of curcumin against heavy metals-induced liver damage, *Food Chem. Toxicol.* vol.69, pp.182–201 ,2014.
21. İ.Demiral, C.Samdan, & H.Demiral, Enrichment of the surface functional groups of activated carbon by modification method. *Surf. Interfaces* ,vol.22, 100873,2021.
22. A. S. Krishna Kumar, S. J.Jiang & W. L. Tseng, Effective adsorption of chromium(vi)/Cr(iii) from aqueous solution using ionic liquid functionalized multiwalled carbon nanotubes as a super sorbent. *J. Mater. Chem. A* 3,Issue.13, pp.7044–7057 ,2015.
23. G.Crini, E.Lichtfouse, L. D.Wilson & N. Morin-Crini, Conventional and non-conventional adsorbents for wastewater treatment. *Environmental Chemistry Letters*, vol.17, pp195-213, 2019.
24. X. Yang, et al,Surface functional groups of carbon-based adsorbents and their roles in the removal of heavy metals from aqueous solutions: a critical review. *Chem. Eng. J.* vol.3,no.66, pp.608–621 ,2019.
25. N. A.Qasem, R. H.Mohammed & D. U.Lawal, Removal of heavy metal ions from wastewater: A comprehensive and critical review. *Npj Clean Water*, vol.4,no.1, pp1-15. 2021.
26. M.Balali-Mood, K. Naseri, Z.Tahergorabi, M. R. Khazdair & M.Sadeghi, Toxic mechanisms of five heavy metals: mercury, lead, chromium, cadmium, and arsenic. *Frontiers in pharmacology*,vol.12, pp.643972, 2021.
27. A. M.Helmenstine ,Heavy Metal Definition and List Cordelia Molloy/Getty Images, 2021.
28. M. T. Hayat, , M.Nauman, N. Nazir, S.Ali, & N.Bangash, Environmental hazards of cadmium: past, present, and future. In *Cadmium toxicity and tolerance in plants* ,Academic Press, pp. 163-183,2019.
29. C. T.Lynch, (Ed.). *Handbook of Materials Science: General Properties*, CRC press,vol.1, 2019.
30. M.Maliki, E. Afehomo & M. O.Ekabafe, THE EFFECT OF ALUM ON HEAVY METAL CONCENTRATION IN WATER SOURCES FROM USEN, EDO STATE, *Journal of Chemical Society of Nigeria*, vol.44,no. 4, 2019.
31. S. B. Pillai, Adsorption in water and used water purification. In *Handbook of water and used water purification* Cham: Springer International Publishing, pp. 99-120. 2024.
32. S.Flatscher, V. P Bharati & A.Dwivedi, Crystallization in Water and Used Water Purification. In *Handbook of Water and Used Water Purification* (pp. 273-296). Cham: Springer International Publishing, 2024.
33. B. K.Arthur, *Suitability of differently coated fluorescent microspheres for simulating sedimentation, sorption and transport of helminth eggs during wastewater treatment of soil infiltration* (Doctoral dissertation, Dissertation, Bochum, Ruhr-Universität Bochum, , 2021.
34. F. O. OGUNDIPE, *DEVELOPMENT OF KAOLIN CLAY, SILVER OXIDE AND ZINC OXIDE NANOCOMPOSITE FILTER FOR DOMESTIC WASTEWATER TREATMENT* (Doctoral dissertation), 2023.
35. H.GÖKÇEKU, Y.Kassem& H. Seman, Review on waste water reuse for irrigation towards achieving environmental sustainability. *International Journal of Engineering and Applied Physics*, vol.3(1), pp.678-688, 2023.
36. S. C.Kim,. Development of air pressure mirroring particle dispersion method for producing high-density tungs*ten medical radiation shielding film. Scientific Reports*, vol.11,no.(1),pp. 485,2021.
37. A. C. D. B. V.Dias, *Chlor-alkali membrane cell process: study and characterization* (Doctoral dissertation, Universidade do Porto (Portugal)).
38. [38] D. J. Lampe, , & J. F. Stolz, Current perspectives on unconventional shale gas extraction in the Appalachian Basin. *Journal of Environmental Science and Health, Part A*, vol.*50*,no.5,pp. 434-446, 2015.
39. Z.Guangyin & Z.Youcai, Chapter Three—Sewage Sludge Solidification/Stabilization and Drying/Incineration Process. *Pollution Control and Resource Recovery for Sewage Sludge; Guangyin, Z., Youcai, Z., Eds*,pp. 101-160,2017.
40. M. R.Lasheen, G.El-Kholy, C. M.Sharaby, , I. Y. Elsherif & S. T. El-Wakeel, Assessment of selected heavy metals in some water treatment plants and household tap water in Greater Cairo, Egypt. *Management of Environmental Quality: An International Journal*,vol. 19,no.3 , pp.367-376, 2008.
41. Y.Liu, H.Wang, Y. Cui, & N.Chen, Removal of copper ions from wastewater: a review. *International Journal of Environmental*, vol.20,no.5, pp.3885, https://doi.org/10.3390/ijerph20053885
42. J. S Zogorski, G. D. Allgeier & R. L. Mullins Jr, Removal of chloroform from drinking water. *Research and Public Health*, vol. 20,no. 5, pp.3885, 1978.
43. N. S. Hadi, Evaluation of Water and Sediment Quality by Bacteriological Diversity Studies on Certain Locations of the Diyala River, Baghdad. *Environment & Natural Resources Journal*, vol.21,no.6, pp. 491-500,2023.
44. J. A. Silva,. Wastewater treatment and reuse for sustainable water resources management: a systematic literature review. *Sustainability*, vol.15,no.14, pp.10940. ,2023

Arabic Abstract

الهدف من معالجة مياه الصرف الصحي هو تقليل كمية الملوثات في المجاري المائية. وتستخدم بعض الدول تقنيات الترشيح البيولوجي، بينما تلجأ دول أخرى إلى الترسيب أو الترشيح. وقد أدت عدة عوامل إلى خفض الانبعاثات الضارة، بما في ذلك التقدم التكنولوجي والتحول نحو إنتاج كميات أقل من المعادن. ومع ذلك، مع تزايد استهلاك المعادن الثقيلة، من الأهمية بمكان مراقبة تركيز هذه الملوثات بيقظة. يتم استخدام قياس الطيف الكتلي ومطياف الامتصاص الذري لتحليل العناصر المختلفة في مياه الصرف الصحي. تعتبر هذه الأدوات التحليلية حيوية في هذه العملية وتحظى بتقدير كبير في الدراسات العلمية.

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The Characterization / Photoreduction of Ternary Pt/AgI/ZnO Nanocomposites: A review

Inam Joudah Radhi[1] , Saad Aziz Hassan[2] , Nahlah Jaber Hussein[3]

[1,3] *The department of chemistry, college of education for pure science, university of Karbala, Karbala, Iraq.*
[2] *The department of chemistry, faculty of education for girls' education, university of Kufa, Iraq.*

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A B S T R A C T

Since photo-catalysis uses light energy to drive chemical processes, it is commonly considered a green technology to help us handle the more pressing environmental and energy issues facing human society. Enhancing the properties of photocatalysts has been a major focus of research and development up to now. Thanks to their remarkable stability and strong catalytic performance, noble metal–ZnO nanocomposites are garnering a lot of interest as potential candidates for catalytic applications in the future.

This research focuses on photosynthesis-inspired studies that tackle global, environmental, and sociological issues such as sustainable agriculture, maintaining the balance of ecosystems, and producing clean energy. This review study presents a thorough explanation of this new class of nanostructures and emphasizes its potential applications across multiple fields, with the goal of encouraging researchers to integrate, investigate, and use multiple new ternary systems.

1. INTRODUCTION

One of the most popular processes for producing nanomaterials is hydrothermal synthesis. In essence, it is a solution-reaction based approach. Through hydrothermal synthesis, nanomaterials can be created at room temperature or exceedingly high temperatures [1].

Photosynthesis is one of the most robust and effective cycles found in natural processes. All of life's energy sources, such as feeding, burning fossil fuels, and, more recently, the industrial synthesis of value-added compounds or bioenergy, are powered by this amazingly simple system [2,3].

Zinc oxide (ZnO) is a cheap, non-toxic catalyst that has fascinating photocatalytic potential, particularly for the removal of pollutants from water. Nevertheless, due to its low efficiency, photocorrosion, and expensive energy recovery, its application has not yet been looked into.Further, (ZnO) is one of the most commonly used benchmark standard photocatalysts in environmental applications. Nevertheless, ZnO's total photocatalytic efficacy is constrained by its wide band gap and frequently occurring photogenerated charge carrier recombination, particularly at the nanoscale [4,5].

[4], ZnO has a wide range of applications. For example, due of its high degree of biocompatibility and optical emission in the visible region, it has recently been used for biotherapeutic applications in the health industry. These qualities have been used in many medical applications, such as the treatment of cancer [6,7,8].

The textile business has a lot of detrimental effects on the environment. The following substances are released into the atmosphere: dust, sulfur, sulfur dioxide, nitrogen oxides, and volatile organic compounds [9,10].

Silver (Ag) is regarded as one of the greatest choices for dopant selection because it may generate an electrical field and increase galvanic owing to surface plasmon resonance (SPR) [11,12]. ZnO/noble metal nanoparticles were produced via the solvothermal technique. The effects of reaction time, the presence of noble metals, and the kind of noble metal (Ag or Pt) have all been studied [13].

This study's photosynthesis-based research tackles global, environmental, and socioeconomic issues such as sustainable agriculture, clean energy generation, and ecosystem balance Figure 1.

*Corresponding Author Institutional Email:
anaam.j@uokerbala.edu.iq (Inam Joudah Radhi)

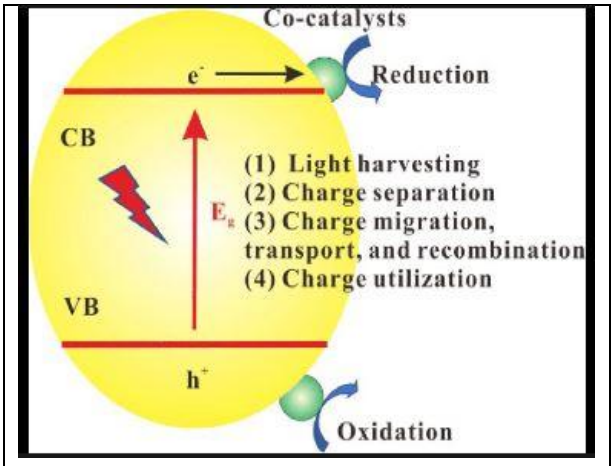

Figure 1. This figure shows the four fundamental stages of photocatalysis [11].

2.PHOTOVOLTAIC CELLS WITH HYDROTHERMAL HEATING

Hydrothermal processing, or "Hydrothermal Upgrading (HTUs)," was created by the Shell Oil Company as a method of converting biomass. The world's population is expanding and businesses are developing quickly.This causes energy demand to constantly rise. Since the industrial revolution, an over use of fossil fuels including coal, oil, and natural gas has resulted in environmental degradation. Fossil fuel combustion results in the atmospheric release of greenhouse gases, such as CO, CO2, NOx, SOx, and CH4. The greenhouse effect and global warming have been connected to these gases. This takes place because the increase in CO2 concentration that is correlated with the effect is what most people perceive to be the main cause of global warming. Unless there is a significant decrease in the quantity of carbon dioxide released into the atmosphere [14,15].

3. NANOCOMPOSITES OF NOBLE METAL/ SEMICONDUCTOR PT/AG/ZNO

Noble metals (Ag, Pt, Cu, and Au) exhibit the tiniest form of surface plasmon resonance (SPR) because their free electrons are able to freely flow through the nanomaterial. A coherent oscillation of all conduction electrons at the metal surface may occur under resonance conditions when the wavelength of the stimulated light is greater than the size of the nanoparticle [16].That is to say, when the excitation radiation and the free confined electrons oscillate at the same frequency, a phenomenon called the Localized Surface Plasmon Resonance (LSPR) is produced [1]. Ag, Pt, Pd, and Au-ZnO nanocomposites exhibit reduced electron-hole pair recombination, which can be used to improve the nano-photocatalytic characteristics of ZnO materials. This is because ZnO-based nanocomposites contain photo-catalytic holes and metal-accumulated electrons. It is possible to use (Ag, Pt, Pd, Au). The (Ag, Pt, Pd, and Au-ZnO) nanocomposites demonstrate reduced electron-hole pair recombination because ZnO-based nanocomposites comprise photo-catalytic holes and metal-accumulated electrons. Noble metal–ZnO nanocomposites have better qualities than ZnO materials.Accordingly, they might eventually take the place of ZnO materials in applications including photocatalysis, energy production, sensors, and converters. Moreover, several topologies of noble metal–ZnO nanocomposites have been described, indicating that noble metal–ZnO may find widespread application in nanotechnology [17, 18]. Numerous studies have been conducted employing tourmaline, graphene, TiO2, and noble metals including Ag, Pt, and Au to increase ZnO's photocatalytic activity. Ag nanoparticles are said to hold the excited electrons as compared to pure Ag metal, resulting in a 34% increase in photocatalytic activity. Ag nanoparticles prevent electron-hole recombination from occurring. ZnO-Ag nanocomposite materials are made by hydrothermal, solvothermal, precipitation, electrodeposition, and sol-gel processes.

The disadvantage of these procedures is that they necessitate numerous processing steps that must be followed by additional steps to remove impurities or leftovers [19,20]. In contrast to ZnO semiconductor which has a broad band gap, AgX (X = I, Br), a type of plasmonic semiconductor, has a tight band gap. This allows AgX to perform exceptionally well in photocatalysis and visible light sensitivity. As a result, AgX has garnered a lot of interest in photocatalysis [21, 22]. Ag/AgBr particles were created by Wang *et al*. using a twofold jet technique. In a different work, Lin *et al*. used a simple in situ ion exchange technique to manufacture AgI/Ag/AgBr. Additionally, when exposed to visible light, it demonstrated outstanding photocatalytic activity for the destruction of MO. AgX's properties make it a popular modification material for wide band gap semiconductors, allowing the semiconductor's light absorption edge to be shifted from the ultraviolet to the visible light area [23-25]. These days, semiconductor photocatalysis has garnered a lot of interest as a successful solution to address these challenges. Additionally, it's generally accepted that composite photocatalysts exhibit superior photocatalytic performance compared to solitary ones. Because these photocatalysts have distinct electronic energy levels, their improved photocatalytic activity can be attributed to the driving force of the internal electric field, which can increase the rate at which photo-generated electron-hole pairs separate and decrease their rate at which they recombine [26-29].

4. PHYSICOCHEMICAL PROPERTIES AND CHARACTERIZATION

Nanoparticles' physicochemical characteristics are important because they show how they interact with the environment or could interact with it under certain conditions. Depending on the intended purpose of the created nanomaterial, specific physicochemical features will take precedence over others. There will always be worries about the composition, texture, optical and electrical qualities, morphological attributes, structure, and potential reaction mechanisms in addition to the stability, reusability potential, and interface system [30,31]. When a substance is brought down to nanometric sizes, significant changes in its properties may occur. To ensure a thorough and credible investigation, these traits must be measured using trustworthy characterization techniques. The sections that follow provide a variety of intriguing ZnO-graphene nanoparticle characterization methods [32-34]. To the best of the researcher's knowledge, resistive random access memory (ReRAM) has been considered a competitive option for next-generation NVM devices. Owing to its exceptional features, which include a low threshold voltage, low power consumption, quick switching times, a simple structural design, and superior storage density, it is beneficial .Resistive switching has been seen in a wide range of materials, including complex oxides, binary metal oxides, and organic compounds. However, the complex production technology of multicomponent oxides impedes their advancement because to the difficult doping control and ReRAM integration [35].

Moreover, it is challenging to use organic materials as a function layer to improve the molecular stability and structure of the ReRAM, which results in lengthy retention and remarkable endurance [36]. Using direct current (DC) magnetron sputtering, three sets of transparent conductive ZnO/Ag/ZnO, or ZAZ, multilayer coatings were produced. Zinc (Zn) and silver (Ag) metallic targets were used for sputtering. Various analytical techniques were used to investigate the effects of the thickness of the Ag layer and the ZnO top layer on the characteristics of the ZAZ multilayer system. Using X-ray diffraction, the effects of the thicknesses of the Ag and ZnO top layers on the structural properties were investigated [37]. Materials with distinct properties at the nanoscale are generally distinct from those at the macroscopic level. Researchers are studying the special biological properties of nanoscale materials with a high volume to surface area ratio for use in a range of applications. ZnO has unusual piezoelectric, optical, and semiconducting characteristics. ZnO-NPs can be produced using a variety of physical and chemical processes, such as sol-gel, pyrolysis, solvothermal, hydrothermal, vapor deposition, laser/vapor deposition, epitaxy, and thermal evaporation**.** Despite being extremely effective, these methods have several disadvantages, like the creation of hazardous waste through chemical reactions and significant energy needs for physical operations [38]. As a result, they have received a lot of attention in the degradation of various contaminants, microorganism disinfection, carbon dioxide photoreduction, hydrogen generation, synthesis of fine chemicals, a crucial component of heterogeneous photocatalysis reactions are semiconductor materials.

Based on a survey of the literature, Ti_{O2} and ZnO are the most widely used heterogeneous photocatalysts because of their non-toxicity, low cost, and good physical and chemical stability [39]. 2,4-Dinitrophenol (DNP), a phenolic pollutant, is considered a priority pollution due to its carcinogenic properties and ability to bioaccumulate in water bodies [39]. Because DNP is extremely stable and resistant to degradation, its removal is difficult. Here, bamboo leaves were used to successfully produce Progressive Graph Convolutional Networks (Pseudo Graph Convolutional Network (PGCN)/AgI/ZnO/ CarbonQuantum Dots (CODs), a Z-scheme assisted quaternary photocatalyst, using the hydrothermal method. In order to efficiently photodegrade DNP as a harmful pollutant, the resulting heterostructure nanocomposite has a designed textural surface, improved optical and electrical characteristics, and a customizable band gap [40]. AgI has a greater negative conduction band potential than the majority of semiconductor materials.More over, when it is put onto other catalyst surfaces, it can efficiently encourage carrier separation.Consequently, it is frequently combined with other semiconductor photocatalytic materials to create innovative visible light-driven photocatalysts. Conversely, AgI's morphology is mostly described as nanoparticles, which is advantageous because it allows it to stick to the surface of substrate photocatalysts with varying topologies and form a stable heterogeneous structure. To increase their photocatalytic activity, scientists have spent the last 20 years constantly creating novel AgI-based composite photocatalysts. AgI-based composite photocatalyst research has reached a tipping point, particularly in the last two or three years Figure 2 [41].

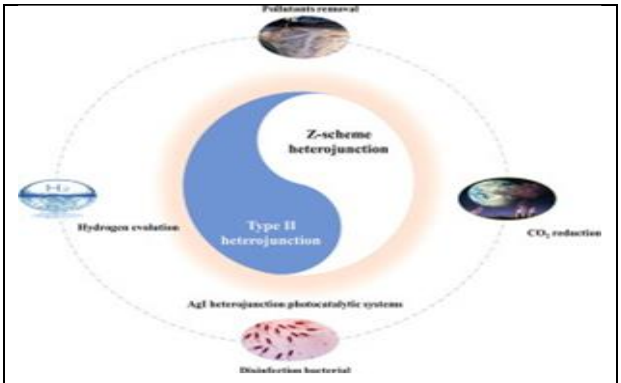

Figure 2. Explained AgI based composite photocatalysts reached a climax [41].

5. REFRENCES

1. Gan, Yong X., Ahalapitiya H. Jayatissa, Zhen Yu, Xi Chen, and Mingheng Li. "Hydrothermal synthesis of nanomaterials." *Journal of Nanomaterials* 2020 (2020): 1-3.
2. Hu, Xinjiang, Weixuan Wang, Guangyu Xie, Hui Wang, Xiaofei Tan, Qi Jin, Daixi Zhou, and Yunlin Zhao. "Ternary assembly of g-C3N4/graphene oxide sheets/BiFeO3 heterojunction with enhanced photoreduction of Cr (VI) under visible-light irradiation." *Chemosphere* 216 (2019): 733-741.
3. Janssen, Paul JD, Maya D. Lambreva, Nicolas Plumeré, Cecilia Bartolucci, Amina Antonacci, Katia Buonasera, Raoul N. Frese, Viviana Scognamiglio, and Giuseppina Rea. "Photosynthesis at the forefront of a sustainable life." *Frontiers in chemistry* 2 (2014): 36.
4. Adnan, Mohd Azam Mohd, Nurhidayatullaili Muhd Julkapli, and Sharifah Bee Abd Hamid. "Review on ZnO hybrid photocatalyst: impact on photocatalytic activities of water pollutant degradation." *Reviews in Inorganic Chemistry* 36.2 (2016): 77-104.
5. Kumar, Amit, Sunil Kumar Sharma, Gaurav Sharma, Mu Naushad, and Florian J. Stadler. "CeO2/g-C3N4/V2O5 ternary nano hetero-structures decorated with CQDs for enhanced photo-reduction capabilities under different light sources: dual Z-scheme mechanism." *Journal of Alloys and Compounds* 838 (2020): 155692.
6. Karbakhsh, A., Othman, I., Ibrahim, Z., Malek, K. and Rincón, Nancy Cervantes, et al. "Enhanced photocatalytic performance of zinc oxide nanostructures via photoirradiation hybridisation with graphene oxide for the degradation of triclosan under visible light: Synthesis, characterisation and mechanistic study." *Journal of environmental chemical engineering* 6.5 (2018): 6554-6567.
7. Salcedo, Alma Berenice Jasso. "Synthesis and performance of nanocomposites based on ZnO for the photocatalytic treatment of water contaminated with endocrin disruptor compounds." PhD diss., Université de Lorraine, 2014.
8. Lellis, Bruno, Cíntia Zani Fávaro-Polonio, João Alencar Pamphile, and Julio Cesar Polonio. "Effects of textile dyes on health and the environment and bioremediation potential of living organisms." *Biotechnology Research and Innovation* 3, no. 2 (2019): 275-290.
9. Ahmad, Khuram Shahzad, and Shaan Bibi Jaffri. "Phytosynthetic Ag doped ZnO nanoparticles: semiconducting green remediators: photocatalytic and antimicrobial potential of green nanoparticles." *Open Chemistry* 16.1 (2018): 556-570.
10. Prajapati, Pankaj Kumar, Neha Saini, Deepak Kumar Chauhan, and Kamalakannan Kailasam. "Unravelling the redox behaviour of a carbon nitride polymer-based ternary heterostructure for CO 2 photoreduction promoted by amine coupling." *Journal of Materials Chemistry A* 11, no. 1 (2023): 385-400.
11. . Muñoz-Fernandez, Lidia, et al. "Solvothermal synthesis of Ag/ZnO and Pt/ZnO nanocomposites and comparison of their photocatalytic behaviors on dyes degradation." *Advanced Powder Technology* 27.3 (2016): 983-993.
12. Liao, Guangfu, Chunxue Li, Shi-Yong Liu, Baizeng Fang, and Huaming Yang. "Z-scheme systems: From fundamental principles to characterization, synthesis, and photocatalytic fuel-conversion applications." *Physics Reports* 983 (2022): 1-41.
13. Ye, Mao, Wei Wei, Lihua Zheng, Yuze Liu, Dewei Wu, Xiangyu Gu, and Ang Wei. "Enhanced visible light photoreduction of aqueous Cr (VI) by Ag/Bi4O7/g-C3N4 nanosheets ternary metal/non-metal Z-scheme heterojunction." *Journal of hazardous materials* 365 (2019): 674-683.
14. Tekin, Kubilay, Selhan Karagöz, and Sema Bektaş. "A review of hydrothermal biomass processing." *Renewable and sustainable Energy reviews* 40 (2014): 673-687.
15. He, Xiang, and Wei-Ning Wang. "MOF-based ternary nanocomposites for better CO2 photoreduction: roles of heterojunctions and coordinatively unsaturated metal sites." *Journal of Materials Chemistry A* 6, no. 3 (2018): 932-940.
16. Mohamed, S. H. "Effects of Ag layer and ZnO top layer thicknesses on the physical properties of ZnO/Ag/Zno multilayer system." *Journal of Physics and Chemistry of Solids* 69.10 (2008): 2378-2384..
17. Saber, Nesrine Ben, Amine Mezni, Arwa Alrooqi, and Tariq Altalhi. "A review of ternary nanostructures based noble metal/semiconductor for environmental and renewable energy applications." *Journal of Materials Research and Technology* 9, no. 6 (2020): 15233-15262.
18. Liu, Hang, Jiatai Feng, and Wanqi Jie. "A review of noble metal (Pd, Ag, Pt, Au)–zinc oxide nanocomposites: synthesis, structures and applications." *Journal of Materials Science: Materials in Electronics* 28.22 (2017): 16585-16597.
19. Li, Ji, and YJ Bill Yang. "New type ternary NiAlCe layered double hydroxide photocatalyst for efficient visible-light photoreduction of CO2 into CH4." *Materials Research Express* 5, no. 2 (2018): 026204.
20. Nurtono, Tantular, Timotius Candra Kusuma, Meditha Hudandini, Widiyastuti Widiyastuti, Manabu Shimada, Suci Madhania, Siti Machmudah, Dewi Puspitasari, Sugeng Winardi, and Kusdianto Kusdianto. "Effect of Ag content in ZnO-Ag nanocomposites prepared by spray pyrolysis method for degradation of textile dye waste." In *AIP Conference Proceedings*, vol. 2219, no. 1. AIP Publishing, 2020.
21. Gong, Shuaiqi, Yanli Niu, Xuan Liu, Chen Xu, Chuncheng Chen, Thomas J. Meyer, and Zuofeng Chen. "Selective CO2 Photoreduction to Acetate at Asymmetric Ternary Bridging Sites." *ACS nano* 17, no. 5 (2023): 4922-4932.
22. Albiter, Elim, Aura S. Merlano, Elizabeth Rojas, José M. Barrera-Andrade, Ángel Salazar, and Miguel A.

Valenzuela. "Synthesis, characterization, and photocatalytic performance of ZnO–graphene nanocomposites: a review." *Journal of Composites Science* 5, no. 1 (2020): 4.
23. Hao, Xiaojie, Ling Tan, Yanqi Xu, Zelin Wang, Xian Wang, Sha Bai, Chenjun Ning, Jingwen Zhao, Yufei Zhao, and Yu-Fei Song. "Engineering active Ni sites in ternary layered double hydroxide nanosheets for a highly selective photoreduction of CO2 to CH4 under irradiation above 500 nm." *Industrial & Engineering Chemistry Research* 59, no. 7 (2020): 3008-3015.
24. Wang, Bingqing, Zirong Deng, Xianzhi Fu, and Zhaohui Li. "MoS 2/CQDs obtained by photoreduction for assembly of a ternary MoS 2/CQDs/ZnIn 2 S 4 nanocomposite for efficient photocatalytic hydrogen evolution under visible light." *Journal of Materials Chemistry A* 6, no. 40 (2018): 19735-19742.
25. Zhao, Xiaofeng, Yi Li, Chunpeng Ai, and Dianzhong Wen. "Resistive switching characteristics of Li-doped ZnO thin films based on magnetron sputtering." *Materials* 12, no. 8 (2019): 1282.
26. Lu, Jia, Huihu Wang, Yifan Dong, Fanqiang Wang, and Shijie Dong. "Plasmonic AgX nanoparticles-modified ZnO nanorod arrays and their visible-light-driven photocatalytic activity." *Chinese Journal of Catalysis* 35, no. 7 (2014): 1113-1125.
27. Hou, Yaqi, Shengyan Pu, Qingqing Shi, Sandip Mandal, Hui Ma, Shengyang Xue, Guojun Cai, and Yingchen Bai. "Ultrasonic impregnation assisted in-situ photoreduction deposition synthesis of Ag/TiO2/rGO ternary composites with synergistic enhanced photocatalytic activity." *Journal of the Taiwan Institute of Chemical Engineers* 104 (2019): 139-150.
28. Lu, Jia, Huihu Wang, Yifan Dong, Fanqiang Wang, and Shijie Dong. "Plasmonic AgX nanoparticles-modified ZnO nanorod arrays and their visible-light-driven photocatalytic activity." *Chinese Journal of Catalysis* 35, no. 7 (2014): 1113-1125.
29. Ao, Yanhui, Jiaqiu Bao, Peifang Wang, and Chao Wang. "A novel heterostructured plasmonic photocatalyst with high photocatalytic activity: Ag@ AgCl nanoparticles modified titanium phosphate nanoplates." *Journal of Alloys and Compounds* 698 (2017): 410-419.
30. Li, Xiaoxuan, Siman Fang, Lei Ge, Changcun Han, Ping Qiu, and Weilong Liu. "Synthesis of flower-like Ag/AgCl-Bi2MoO6 plasmonic photocatalysts with enhanced visible-light photocatalytic performance." *Applied* 31. Holbrey, John D., Robin D. Rogers, Rob A. Mantz, Paul C. Trulove, Violina A. Cocalia, Ann E. Visser, Jessica L. Anderson et al. "Physicochemical properties." *Ionic liquids in synthesis* 2 (2008).
31. Egharevba, Henry Omoregie. "Chemical properties of starch and its application in the food industry." *Chemical properties of starch* 9 (2019).
32. Yasuda, H., E. J. Charlson, E. M. Charlson, T. Yasuda, M. Miyama, and T. Okuno. "Dynamics of surface property change in response to changes in environmental conditions." *Langmuir* 7, no. 10 (1991): 2394-2400.
33. Fishman, M. L., B. Levaj, D. Gillespie, and R. Scorza. "Changes in the physico-chemical properties of peach fruit pectin during on-tree ripening and storage." *Journal of the American Society for Horticultural Science* 118, no. 3 (1993): 343-349.
34. Kwon, WookHyun, Tsu-Jae King Liu, and Vivek Subramanian. "Novel Technologies for Next Generation Memory." PhD diss., 2013.
35. Mohamed, S. H. "Effects of Ag layer and ZnO top layer thicknesses on the physical properties of ZnO/Ag/Zno multilayer system." *Journal of Physics and Chemistry of Solids* 69.10 (2008): 2378-2384.
36. Hameed, Safia, et al. "Greener synthesis of ZnO and Ag–ZnO nanoparticles using Silybum marianum for diverse biomedical applications." *Nanomedicine* 14.6 (2019): 655-673.
37. Carolin, C. Femina, P. Senthil Kumar, A. Saravanan, G. Janet Joshiba, and Mu Naushad. "Efficient techniques for the removal of toxic heavy metals from aquatic environment: A review." *Journal of environmental chemical engineering* 5, no. 3 (2017): 2782-2799.
38. Pirhashemi, Mahsa, and Aziz Habibi-Yangjeh. "Preparation of novel nanocomposites by deposition of Ag2WO4 and AgI over ZnO particles: efficient plasmonic visible-light-driven photocatalysts through a cascade mechanism." *Ceramics International* 43, no. 16 (2017): 13447-13460.
39. Otitoju, Oluwaferanmi B., Moses O. Alfred, Olumuyiwa O. Ogunlaja, Chidinma G. Olorunnisola, Olumide D. Olukanni, Aemere Ogunlaja, Martins O. Omorogie, and Emmanuel I. Unuabonah. "Pollution and risk assessment of phenolic compounds in drinking water sources from South-Western Nigeria." *Environmental Science and Pollution Research* (2023): 1-20.
40. Hasija, Vasudha, Anita Sudhaik, Pankaj Raizada, Ahmad Hosseini-Bandegharaei, and Pardeep Singh. "Carbon quantum dots supported AgI/ZnO/phosphorus doped graphitic carbon nitride as Z-scheme photocatalyst for efficient photodegradation of 2, 4-dinitrophenol." *Journal of Environmental Chemical Engineering* 7, no. 4 (2019): 103272
41. Wen, Xiao-Ju, Chun-Hui Shen, Zheng-Hao Fei, Dong Fang, Zong-Tang Liu, Jing-Tao Dai, and Cheng-Gang Niu. "Recent developments on AgI based heterojunction photocatalytic systems in photocatalytic application." *Chemical Engineering Journal* 383 (2020): 123083.

Arabic Abstract

بما أن التحفيز الضوئي يستخدم الطاقة الضوئية لدفع العمليات الكيميائية، فإنه يعتبر عادةً تقنية خضراء لمساعدتنا في التعامل مع القضايا البيئية والطاقة الأكثر إلحاحًا التي تواجه المجتمع البشري. لقد كان تعزيز خصائص المحفزات الضوئية محورًا رئيسيًا للبحث والتطوير حتى الآن. بفضل ثباتها الملحوظ وأدائها التحفيزي القوي، تحظى المركبات النانوية المصنوعة من المعدن النبيل وأكسيد الزنك بالكثير من الاهتمام كمرشحين محتملين للتطبيقات الحفزية في المستقبل.
يركز هذا البحث على الدراسات المستوحاة من عملية التمثيل الضوئي والتي تتناول القضايا العالمية والبيئية والاجتماعية مثل الزراعة المستدامة، والحفاظ على توازن النظم البيئية، وإنتاج الطاقة النظيفة. تقدم هذه الدراسة المراجعة شرحًا شاملاً لهذه الفئة الجديدة من الهياكل النانوية وتؤكد على تطبيقاتها المحتملة عبر مجالات متعددة، بهدف تشجيع الباحثين على دمج الأنظمة الثلاثية الجديدة المتعددة والتحقيق فيها واستخدامها.