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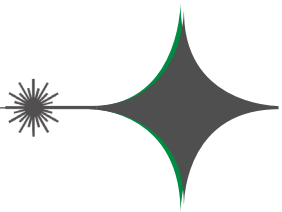

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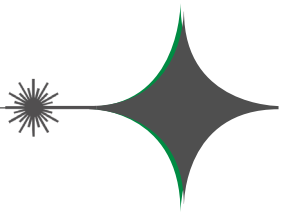

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Estimation of the Serum Ischemia Modified Albumin (IMA) and B-Type Natriuretic Peptide (BNP) Levels in Adult Beta-Thalassemia Major Patients in Baghdad-Iraq

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A B S T R A C T

Background: Beta thalassemia major (β-T) is a prevalent genetic disorder worldwide that arises from a lack of globin chains. Ischemia-modified albumin (IMA) is a variant of the albumin protein that is produced in response to oxidative stress. It serves as a blood biomarker for tissue damage and myocardial ischemia. Cardiovascular disease is a widespread global health issue that results in mortality. In order to effectively prevent disease progression and administer appropriate treatment, it is crucial to diagnose the condition in its early stages by examining the extent of cardiac damage.
Objective: to quantify the levels of IMA in patients with β-thalassemia major (β-T) and compare them to those of healthy individuals. Additionally, we aim to evaluate the correlation between IMA levels and BNP.
Methods: Sixty participants were enrolled in this study in order to assess their serum IMA levels. 30 Beta-Thalassemia Major patients and 30 healthy individuals were included in this investigation, all of whom showed no signs of heart disease. The ELISA method was employed to determine the levels of serum IMA and BNP.
Results: Serum IMA and BNP increased in Beta-Thalassemia Major patients when compared with control healthy subjects ($P < 0.001$). There was no correlation between serum IMA and BNP in the patients' group.

1. INTRODUCTION

Thalassemia is a prevalent global disease characterized by the fast breakdown of red blood cells. To sustain their red blood cell count, patients must undergo regular blood transfusions. Regular blood transfusions, nevertheless, result in excessive accumulation of iron in the body, which can give rise to issues such as osteoporosis, diabetes, cardiovascular disease, and renal disease [1]. Thalassemia is mainly classified into two types: alpha-thalassemia and beta-thalassemia. Beta-Thalassemia is categorized into major, moderate, and mild forms according to clinical criteria [2].

Beta thalassemia is a condition where there are abnormalities in the production of the beta chains of hemoglobin. This can lead to a range of symptoms, from severe anemia to individuals who show no clinical symptoms. The global yearly prevalence of symptomatic persons is believed to be 1 in 100,000, while in the European Union, it is predicted to be 1 in 10,000. Three primary forms have been identified: thalassemia minor, thalassemia intermedia, and thalassemia major [3].

Beta thalassemia major patients if untreated leads to increase cardiac output that results in left ventricular hyperatrophy end with heart failure. Iron

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overload will result in peroxidationand cellular injuries. Also, cardiac arrhythmia like atrial fibrillation, ventricular tachycardia and superaventricular tachycardia are increased because of increased cardiac siderosis [4]

Ischemia Modified Albumin IMA is a new marker that indicates the presence of oxidative stress and tissue ischemia. The pathophysiological events of ischemia, such as the presence of reactive oxygen species and lack of oxygen, result in a structural alteration of albumin at the N-terminus [5].

Elevated levels of ischemia-modified albumin (IMA) can be an early sign of permanent necrosis in cardiomyocytes. When comparing the biochemicals associated with myocardial injury in patients with acute coronary syndrome, specific markers can be detected at an earlier stage and with higher sensitivity than other compounds. IMA levels also increase during myocardial ischemia-reperfusion injury, which is associated with oxidative stress resulting from both cardiac and non-cardiac events [6].

B-type natriuretic peptide (BNP) is a cardiac hormone secreted by the myocardium of the left ventricle in response to increased pressure or volume in the heart. BNP stimulates sodium excretion and causes the narrowing of blood vessels to control the amount of blood and the pressure within it. Elevated BNP levels are observed as the left ventricular function worsens [7].

2. MATERIALS AND METHODS

2.1 Patients and Control

The samples collected at the beginning of the study were 60 subjects selected with an age range (18-30 years) living in Baghdad; each patient completed a questionnaire sheet that included the following information: code number, name, age, gender, date, address, ethnicity, family history of thalassemia, weight, length, and medical history. In this cross sectional study was performed in the Ibn Albaladi Center of Blood Diseases (during the period from 1st of March 2023 to the end of August 2023). These subjects were divided into two groups: 30 Beta-Thalassemia Major patients without any symptoms of heart dysfunction, and 30 normal subjects. Patients with cardiovascular disease were excluded in this study. Consent has been acquired from all patients and healthy volunteers, or their parents, for this study, and it was publically acknowledged.

2.2 Statistics

Continuous data were described as mean± SD (Standard Deviation). The student's t-test has been used to examine and compare the means of the markers and variables between the patients and control group. A Pearson correlation analysis was conducted to determine if there was a significant association between the parameters. The alpha level for statistical significance was set to $p < 0.05$. Statistical analysis was measured using the program MedCalc version 19.6.1

2.3 Blood Sampling

Blood samples collected from subjects before the blood transfusion in the morning at 8:00 a.m- 11:00 a.m. The sample was obtained by collecting blood from the vein using a 10 ml disposable syringe. The collected sample was then placed in tubes that contained a gel, which aids in the separation of serum. Blood kept in gel tubes was allowed to clot at 37°C approximately at 10 min and then centrifuged at 2000 Xg for 15 min then the serum was divided and stored at (-20°C) by using sterilized eppendrof tubes, 0.5ml of serum used until analysis Serum IMA and Serum BNP. Determination of Serum IMA and BNP by enzyme - linked immunosorbent assay (ELISA) kits which are sandwich enzyme immunoassay for in vitro quantitative measurement [Ischemia-Modified- Albumin-(IMA)-CEA825Hu and Brain Natriuretic Peptide (BNP)-CEA541Hu Cloud-Clone Corp (USA).

3. RESULTS

Demographic characteristics of the β-Thalassemia major Group (n = 30) and control subjects (n =30) enrolled in the present study are shown in Table (1). There was no significant difference in the frequency distribution of individuals according to sex between beta thalassemia major and control group, with 17 (57.0 %) and 13 (43.0 %) males and females in each group.

In **Table 1** and **Figure 1**, the Mean±SD for age across the groups was statistically similar, as indicated by the p-value of 0.987.

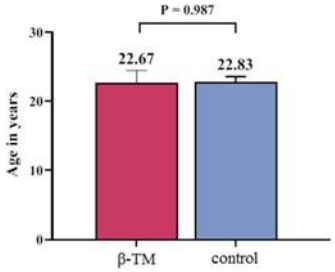

Figure 1. Means of age by Groups with 95.00% CI Error Bars

TABLE 1. Demographic and laboratory data among β-thalassemia major (β-TM) and controls groups

parameter	Controls (n = 30)	β-Thalassemia Major (β-TM) (n = 30)	P value
Male	17/30	17/30	1
Female	13/30	13/30	1
Age (Years)	22.83± 2.03	22.67± 4.78	0.987
IMA ng/mL	2310.63± 1490.97	7834.33± 993.00	<0.001
BNP (pg/mL)	96.63± 16.13	361.63± 74.72	<0.001

Note: Each parameter's mean and standard deviation (Mean± SD) are provided, along with the p-value indicating the significance of the differences between the groups.

In the case of S.IMA, β-Thalassemia Major (β-TM) Group demonstrates the highest Mean±SD value 7834.33±181.30 (ng/mL), against the control Group with 2310.63±272.21(ng/mL). The p-value< 0.001, indicating significant differences between the groups, Figure 2.

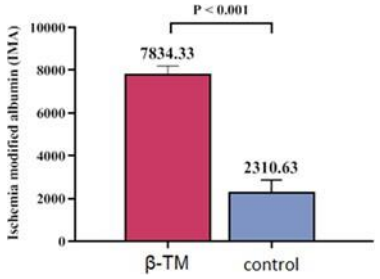

Figure 2. Means of IMA by groups with 95.00% CI error bars

In this study, it was shown that BNP levels were elevated in the β-TM group had Mean±SD (361.63±74.72 pg/mL) compared with the healthy control group had Mean±SD (96.63±16.13 pg/mL). exhibit significant differences with p-value < 0.001, Figure 3.

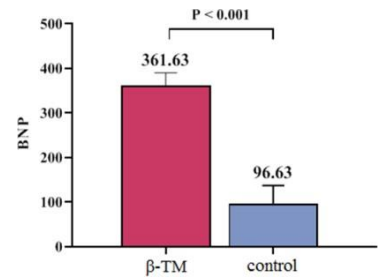

Figure 3. Means of BNP by Groups with 95.00% CI Error Bars

No correlation exists between Age, IMA and BNP as shown in **TABLE 2**

TABLE 2. Correlation matrix (Pearson) / Group Group B:

Variables	Age	BNP	IMA
Age	**1**	0.08	0.1
BNP	0.08	**1**	-0.23
IMA	0.1	-0.23	**1**

4. DISCUSSION

This study showed no significant difference in distribution between male (57.0 %), female (43.0 %) patient and control groups. Brain (B-type) natriuretic peptide (BNP) is a neurohormone that is produced and released by the heart ventricles when there is an increase in wall tension. The level of this factor is elevated in patients suffering from heart failure, myocardial infarction, and unstable angina. The extent of the increase is directly related to the severity of left ventricular (LV) dysfunction. However, other illnesses can cause elevated BNP levels, either cardiac, such as acute coronary syndromes, pulmonary embolism, tachyarrhythmias, and cardioversion, or non-cardiac, such as anemia [8].

This study demonstrated that thalassemia patients in the Group had higher BNP levels than the healthy control group. The results are comparable to those reported by(Mohammed et al 2019) [9].

The most important complications in patients with beta thalassemia major are cardiomyopathy and various types of arrhythmias.in patients with beta thalassemia major anemia leads to increase cardiac output that results in left ventricular hyperatrophy end with heart failure. Iron overload will result in peroxidationand cellular injuries. As results of iron overload that cause left ventricular cardiomyopathy. Also, cardiac arrhythmia like atrial fibrillation ventricular tachycardia and superaventricular tachycardia are increased according to increased cardiac siderosis [4].

The main causes of cardiomyopathy in patients with thalassemia are increasing intestinal absorption of iron, hemolysis, and lifelong blood transfusions. When intracellular iron increases, it is metabolized, releasing reactive oxidative species, which damage the cell membrane, and interfere with the respiratory chain in the mitochondria resulting in cardiotoxicity [10].

Serum IMA of β-TM patients Group was significantly higher than that of control group. Previous studies had shown that children with β-Thalassemia had significantly greater levels of IMA compared to healthy controls [11].

Albumin is a highly prevalent protein found in the bodies of mammals. Its characteristics undergo alterations during ischemia events that are linked to oxidative stress, acidosis, and the generation of reactive oxygen species. Under these circumstances, the presence of ischemia leads to the production of IMA, which has a diminished ability to bind to metals, particularly transition metals [12].

Iron overload in thalassemia leads to elevated levels of reactive oxygen species (ROS), which significantly contribute to the formation of intramolecular aggregates (IMA). Recently, it has been discovered that IMA is a final result of oxidative stress. Higher concentrations of IMA may indicate a state of oxidative stress that affects the entire body rather than being limited to a specific organ. Studies have shown that persons with thalassemia have a reduced ability to counteract the harmful effects of oxidants. Thus, it is imperative to utilize efficient iron chelators in order to eliminate the harmful iron ions and prevent oxidative harm to the essential organs [11].

In addition, recent laboratory studies have shown that the production of hydroxyl radicals (•OH) through the Fenton reaction is linked to a sudden increase in the concentration of IMA. Based on these data and considering the presence of oxidative stress, increased formation of reactive oxygen species (ROS), reduced antioxidant defense systems, hypoxia, and anemia in thalassemia patients, it is reasonable to expect higher levels of ischemia-modified albumin (IMA) in these individuals. The primary factors that are most likely responsible for the alteration of the N-terminus of serum albumin and the subsequent increase in levels of IMA in thalassemia patients are iron-induced oxidative stressors in conjunction with chronic anemia and hypoxia [13]. The increase in B-type natriuretic peptide (BNP) and ischemia-modified albumin (IMA) in thalassemia patients without cardiac dysfunction could be due to a higher degree of cardiac strain and injury,which leading to elevated levels of these biomarkers without any symptoms of heart dysfunction [14]. This could stem from factors such as chronic anemia, increased iron deposition, or other complications [15].

non-cardiac factors such as inflammation, oxidative stress, and endothelial dysfunction may play a more prominent role in elevating these biomarkers in patients without cardiac dysfunction. These factors can contribute to myocardial injury and dysfunction [16].

5. CONCLUSION

Iron overload and oxidative stress pathways in β-TM patients led to higher levels of IMA. Elevated levels of IMA (ischemia-modified albumin) and BNP (B-type natriuretic peptide) in β-thalassemia major (β-TM) individuals who show no signs of cardiac failure could be a significant signal. This abnormality may arise during the early stages of heart disease.

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Arabic Abstract

خلفية البحث: بيتا ثلاسيميا الكبرى هو اضطراب وراثي منتشر في جميع أنحاء العالم ينشأ من نقص سلاسل الجلوبين. الألبومين المعدل الإقفاري هو أحد أنواع بروتين الزلال الذييتم إنتاجه استجابةً للإجهاد التأكسدي. إنه بمثابة علامة حيوية للدم لتلف الأنسجة ونقص تروية عضلة القلب. أمراض القلب والأوعية الدموية هي مشكلة صحية عالمية واسعة النطاق تؤدي إلى الوفيات. من أجل منع تطور المرض بشكل فعال وإدارة العلاج المناسب، من الضروري تشخيص الحالة في مراحلها المبكرة من خلال فحص مدى الضرر الذي يصيب القلب.

الاهداف: قياس مستويات الألبومين المعدل الإقفاري في المرضى الذين يعانون من الثلاسيميا الكبرى ومقارنتها بمستويات الأفراد الأصحاء. بالإضافة إلى ذلك، نحن نهدف إلى تقييم العلاقة بين مستويات الألبومين المعدل الإقفاري وببتيد مدر الصوديوم الدماغي نوع ب .

المرضى وطرق العمل/ المواد وطرق العمل: تم تسجيل ستين مشاركا في هذه الدراسة من أجل تقييم مستويات الألبومين المعدل الإقفاري في مصلهم. تم تضمين 30 مريضًا من مرضى بيتا الثلاسيميا الكبرى و30 شخصًا سليمًا في هذا البحث، ولم تظهر عليهم جميعًا أي علامات لأمراض القلب. تم استخدام طريقة الالايزا لتحديد مستويات الألبومين المعدل الإقفاري وببتيد مدر الصوديوم الدماغي نوع ب في الدم .

النتائج: مصل الألبومين المعدل الإقفاري وببتيد مدر الصوديوم الدماغي نوع ب زاد في مرضى بيتا ثلاسيميا الكبرى بالمقارنة مع الأشخاص الأصحاء. لم يكن هناك ارتباط بين مصل الألبومين المعدل الإقفاري وببتيد مدر الصوديوم الدماغي نوع ب في مجموعة المرضى .

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Silver Sulfide Nanostructures: Synthesis and Characterization

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Chemical precipitation

A B S T R A C T

Ag_2S semiconductor nanoparticles were prepared successfully using the chemical precipitation method. The XRD pattern shows that the Ag_2S particles are crystalline with a monoclinic phase. "Debye-Scherrer" formula was used to calculate the crystal size and it was found to be 64.22 nm. According to FE-SEM images, all particles have a spherical shape. The band gap for Ag_2S was estimated from the optical absorption curve and it was 3.89 eV.

1. INTRODUCTION

Characteristics of semiconductor nanostructured materials are well understood and they depend on their size, shape, and surface charge [1,2] . Chalcogenides of transition metals are used [3], with their remarkable photoelectron transformation capabilities and prospective applications, in chemistry ,physics [4,5] ,biology, medicine, and materials science[6]. They are also used as important components in solar cells, photovoltaic devices, sensitive sensors, and slow-release medication[7,8]. Due to its excellent optoelectronic qualities, Ag_2S is one of the most significant chalcogenides[9]. At the nanoscale level, Ag_2S exhibits electronic and optoelectronic properties which lead to use them in many applications such as in electrical and optical devices [10]. Owing to the narrow band gap (0.9-1.05 eV) [11,12], silver sulfide nanoparticles reveal photoelectric and thermoelectric properties. Ag_2S is a significant chalcogenide that finds widespread use in a variety of scientific and technological fields[13,14], including IR detectors, photovoltaic cells, electrochemical storage cells, and photoconducting cells [15]. It is also widely known for its ability to function as mixed conductor of ions and electrons at temperatures higher than 200°C[16,17]. Some chemical and physical methods are used to synthesize Ag_2S nanoparticles, including chemical bath deposition (CBD), spray pyrolysis deposition (SPD), sequential ionic layer adsorption reaction (SILAR), molecular beam epitaxy (MBE), gamma irradiation, thermal evaporation, and sol-gel, and ion implantation techniques [11, 18]. The purpose of this work was to use the chemical precipitation approach to explain the growth process of silver sulfide nanostructures. By adjusting variables including pH, precursors' concentration, reaction time, and reaction temperature, the structural and optical features of the synthesized Ag_2S nanoparticles can be controlled. Previously, chemical precipition approache is used to prepare Ag_2S nanorods because it is an environmentally friendly and inexpensive method. The authors used silver nitrate and thiourea as starting materials with different molar concentration.[19] Emadi group used sonochemical method to fabricate Ag_2S nanoparticles. The authors used thioacetic acid as a source for sulphide and they found that the ultrasound radiation with 60 W for 20 minutes radiation was capable to produce nanoparticles with an average size of 11.8 nm.[20]

2. MATERIALS AND METHODS

2.1 Chemical Substances

Silver acetate (99.9%, CH_3CO_2Ag) and sodium sulfide (99%, Na_2S) were purchased from THOMAS BAKER, deionized water was used as a solvent.

2.2 Preparation of Silver Sulfide

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To create silver sulfide nanoparticles, first. 0.16691 g of silver acetate was dissolved in 100 mLof deionized water and stirred. No particles were visible. This produced 0.01 M of silver acetate. Silver acetate solution was mixed with 100 mL of 0.01 M sodium sulfide solution .The solution was stirred for an hour at 50˚C on the magnetic stirrer Maintaining the temperature while stirring after the addition was finished. After centrifugation at 4000 rpm, the precipitate was finally recovered and dried at 50˚C for three hours**.** preparation equation**.**

$Na_2S + 2AgC_2H_3O_2 \rightarrow Ag_2S + 2NaC_2H_3O_2$

3. CHARACTERIZATION AND INSTRUMENTATIONS

To characterize the crystal properties of the prepared silver sulphide, X-ray diffraction, was used. Structural properties of Ag_2S nanoparticles were determined using field emission scanning electron microscopy (FE-SEM). Elemental analysis was performed using EDX. Fourier Transform Infrared Spectroscopy, also known as FTIR was used to study the functional groups of prepared sample. The band gap was investigated from the UV-Vis chart using tauc equation.

4. RESULT AND DISCUSSIONS

The XRD chart, which is shown in Figure 1, showed the appearance of many narrow diffraction peaks indicating the crystalline nature. According to JCPDS Card No .14-0072, peaks appeared at 26.32°, 28.97º, 31.51º, 33.62º, 34.39º, 36.82º, 37.73º, 40.75º, 43.40º, 47.77º, 48.76º, 53.27º, 58.36º, and 63.75º are corresponding to -101, 111, -112, 120, -121, 121, -103, 031, 200, 023, 113, 311, 212, 222, 024, and 034 diffraction planes.

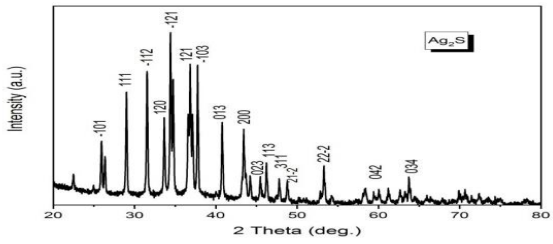

Figure 1. XRD pattern of Ag_2S nanoparticles**.**

The diffraction angle of 34.39º was used to obtain the crystallite size of Ag_2S particles Scherrer equation 22D equals $D = K\lambda / \beta \cos\theta$. Here, θ is the diffraction angle , K is a constant equal to 0.9 and β is the full width at half maximum., and the wavelength of the Cukα is1.54056 E [21].

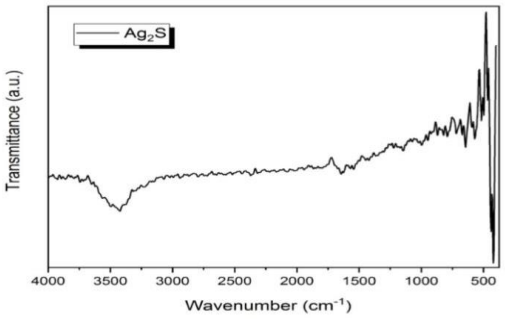

Figure 2. FTIR Spectrum of Ag_2S Nanoparticles.

Figure2 shows the FTIR spectrum of Ag_2S nanoparticles. The peaks that appeared in the range of 400–600 cm^{-1} are related to Ag–S bonds, supporting the formation of silver sulfide nanoparticles. The structural properties of the prepared particles were determined from the FE-SEM images. It is clear from the image in Figure 3 that the particles are spherical and their average size is calculated using imageJ program and it is found to be 64.3 nm.

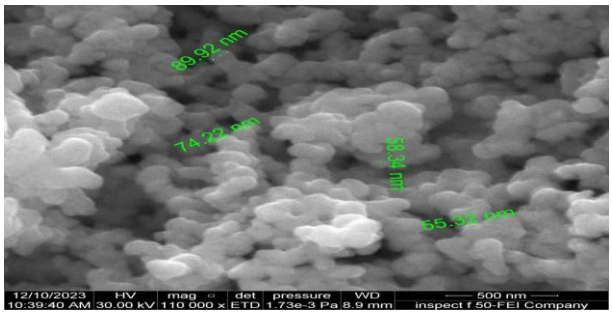

Figure 3. FE-SEM images of Ag_2S nanoparticles.

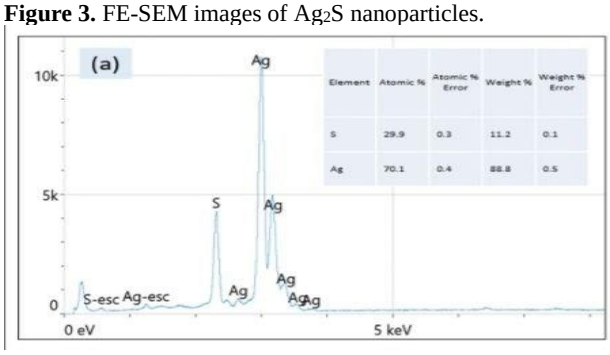

Figure 4. EDS chart of Ag_2S particles.

The presence of silver and sulphide elements within Ag_2S nanoparticles was confirmed using EDS chart. It is clear from Figure 4 that our sample has no impurities due to the absence of any peak except for silver and sulphide.[22] The atomic percentage for Ag is 70.1%, and for S is 29.9%.

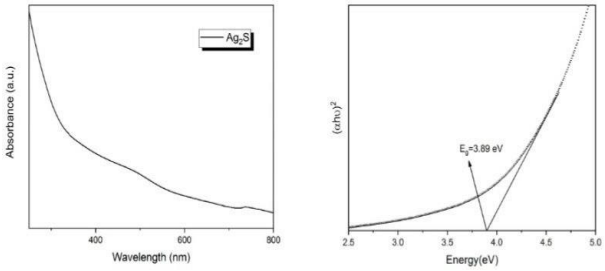

Figure 5. UV_V is absorbance spectrum for silver sulfide nanoparticles and band gap energies of Ag2S nanoparticles.

is absorbance spectrum of silver sulphide nanoparticles (leaft image) and the band gap energy of Ag_2S nanoparticles (right image).

The optical properties of Ag_2S were studied using UV-Vis spectroscopy. It is clear from Figure 5 that the absorption band edge [23] of the as- prepared nanoparticles is around 550 nm. The band gap energy, calculated using Tauc's equation, is 3.89 eV. This value is larger than that of bulk Ag_2S(0.9-1.05 eV) [24], suggesting the effect of quantum confinement as the size of the particles decreases.

5. CONCLUSTION

In this study Ag2S nanoparticles were fabricated using chemical precipitation technique. The crystal properties of particles were confirmed by XRD patterns. It seems that the particles are monoclinic with a crystallite size of 64.22356 nm. Most of Ag2S particles are spherical in shape with an average diameter of 64.3 nm. Their optical properties show that the as-prepared particles are in nanoscale level due to the value of band gap (3.89 eV) which is greater than that of bulk Ag2S that is possibly related to the quantum size effect.

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Arabic Abstract

في هذه الدراسة تم تصنيع الجسيمات النانوية Ag_2S باستخدام تقنية الترسيب الكيميائي. تم تأكيد الخصائص البلورية للجسيمات بواسطة مخطط XRD ويبدو أن الجسيمات أحادية الميل بحجم بلوري قدره 64.22 nm. معظم جسيمات Ag_2S كروية الشكل ويبلغ متوسط قطرها 64.3 nm. أظهرت خصائصها البصرية أن الجسيمات المحضرة موجودة على مستوى النانو بسبب قيمة فجوة النطاق (3.9 فولت) والتي هي أكبر من قيمة Ag_2S السائبة والتي ربما تكون مرتبطة بتأثير الحجم الكمي.

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A Study of the Calculation of The Ratio of Red and White Muscles in Grass Carp (Valeneciennes, 1844) Ctenopharyngodon Idella and Silver Carp (Valeneciennes, 1844) Hypophthalmichthys Molitrix in the Holy Karbala Governorate

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P A P E R I N F O

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muscles, red fiber, white fiber, fishes.

A B S T R A C T

This study was conducted on two types of bony fish that live in fresh water, (50) fishes were collected with five groups of different lengths.The study results in a sharp difference in the rate of ratio of red and white muscles based on the examined body area and the length group studied.The rates of red muscle ratios increased with the increment of the average of total length of fish as we headed towards the caudal area of the body, This is proven by the study of the correlation relationship, which ranged the value of the correlation coefficient (0.991,0.993), and the rates of total red muscle ratios in grass carp ranged between (12.34-20.18%), and in silver carp was between (14.43-22.18%), while the rates of total white muscle ratios in grass carp ranged between (87.31-79.60%), and in silver carp was between (85.50-77.49%), Thus, it is clear that the rates of white muscle ratios decrease with the increment of the average of total length of the fish as we head towards the caudal area of the body, This is proven by the study of the correlation relationship, which ranged the value of the correlation coefficient (-0.995, -0.988). Additionally, the statistical analysis of the results found out the differences recorded by calculating the total rates of the ratio of red and white muscles, as well as their rates within the studied body areas. There are significant differences ($p<0.05$) in grass and silver carp, grass and silver carp fish were considered among the steadfast fish, because they contain high rates of red muscles and they practice swimming in a slow, continuous and long way. The study involves a comparison about move active for studying fishes through measurement resparetary surface area, and measurement red and white muscles ratio. This study is the first of its kind locally.

1. INTRODUCTION

Iraq contains plenty of water areas estimated to be (5%) of its entire area represented by the Euphrates and Tigris rivers and their tributaries with marshes, reservoirs, lakes in addition to Shatt al-Arab extending from north to south till the Arabian Gulf.Additionally, there are the artificial ponds that are widely spread in the center and south specialized in breeding and propagating fish, and if invested perfectly, it would have been sufficient to meet the daily needs and more than that [1]. Local Iraqi fish represent a source of daily consumption in human life because it contains high nutritional value as well as health benefits in its muscles, which represent a fresh healthy food for humans [2].Bony fish is one of the largest varieties widespread and diverse in fresh and salty aquatic environments. it includes more than (20,000) species [3], and this breed is characterized by the fact that its internal structure consists of bones, and its lungs have evolved into bladders for floating that act as a part of water balance by controlling the amount of air in the air bladder [4]. However, in terms of external appearance there are multiple forms of it such as the compact form from the sides, or from the bottom up, or streamliner, or the snake, etc. . It is one of the animals with variable temperature [5], and grass carp is called exotic fish, which is an economic fish as it reaches large sizes that benefit the consumer (Bardach et.al.,1972).On the other hand, silver

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Zubaida M. N. Al-Musawi, Muhammad W. H. Al-Muhanna, A Study of the Calculation of The Ratio of Red and White Muscles in Grass Carp (Valeneciennes, 1844) Ctenopharyngodon Idella and Silver Carp (Valeneciennes, 1844) Hypophthalmichthys Molitrix in the Holy Karbala Governorate, Pure Sciences International Journal of Kerbala, Vol. 1 No. 4, (2024) 22-27

carp is called thick front head, and can reach a length of about one meter and sometimes weigh about (30) kilograms [6].

Muscle tissues of the fish occupy most of the body weight compared to other vertebrate animals, as it constitutes about (30-70%) of the total body weight in most types of fish, and extends from the head area to the tail and on both sides of the body of the fish [7] .This study aims to find out the differences related to the activity of movement by studying the histological characteristics of the red and white muscle by examining the ratio of muscle fiber in the different areas of the body (R1, R2).

2. MATERIALS AND METHODS

For this study, (50) fish of the two types studied from the Euphrates River were collected from different locations along the river within the Hindiya district, for the period from the beginning of November 2023 to the end of January 2024, using nets of different sizes.The ratio of red and white muscles were calculated according to the method shown below [8].

3. STATISTICAL ANALYSIS

differences between the total height of fish and the rates of red and white muscle ratios were tested according to the Statistical Package for Social Sciences 16.

4. RESULTS

The results of the current study to calculate the total rate of red muscle ratios showed a clear difference in the values of their rates in the length groups and in the two types studied.The values of their rates in grass carp ranged between (12.18 - 20.18%), while the values of their rates ranged between (18.18-14.43%) in the two silver carp fish as presented in Table (1 and 2).It was mentioned that the red muscle ratios vary according to the areas of the body studied in one fish. Thus, the rates of red muscle ratios in the back region (R2) were greater than their percentages in front area near the head (R1) .In the two types studied, and when analyzing these results statistically to clarify the differences recorded for the total red muscle ratios calculated for the studied weight groups, significant differences ($p<0.05$)) were observed in the two types studied as presented in **TABLE 3** On the other hand, the results of the statistical analysis to clarify the differences recorded for the red muscle ratios of the studied weight groups in the studied body areas (R1) and R2) noted the existence of significant differences ($P<0.05$) in the two types studied as presented in Table [4].

white muscles calculated for the studied weight groups, significant differences ($P<0.05$)) were observed in the two types studied as shown in Table (3).When analyzing the results of the statistical analysis to clarify the differences recorded for the ratio of white muscles for the studied weight groups in the studied body areas (R1 and R2), significant differences ($P<0.05$)) were observed in the two types studied as shown in Table [4].

The results of calculating the total rate of white muscle ratios showed a clear difference in the values of their rates for the studied length groups for the two types studied, as the values of their rates ranged in grass carp (79.60% - 87.13) while their rates ranged between 77.49 - 85.50) %) in silver carp as shown in Table (1 and 2). The ratio of white muscles vary according to the two body areas studied in one fish. It was observed that the ratio of white muscle in the posterior region (R2) are lower than those in the anterior region near the head (R1) in the two types studied. When analyzing the results statistically to clarify the differences recorded for the ratio of white muscles calculated for the studied weight groups. There were significant differences ($P<0.05$) in the two types studied as shown in Table 3. When analyzing the results of the statistical analysis to clarify the differences recorded for the proportions of white muscles for the studied weight groups in the studied body areas (R1 and R2), significant differences ($P<0.05$)) were noticed in the two examined types as shown in Table 4.

TABLE 1. Values of sums of lengths, weights and ratios of red and white muscles in the studied body regions (R1 and R2) in grass carp *C. idella*

Total Length range (mm)	NO. of Fishes	Total length average (mm)	Weight average	Percentage of red muscle average (%)		Percentage of white (%) muscle average		Total red muscle average (%)	Total white muscle average (%)
				R1	R2	R1	R2		
345-300	10	329.21 ± 2.15	1418.65 ± 1.59	11.15 ± 0.13	13.53 ± 0.07	88.14 ± 1.78	86.12 ± 2.34	12.34	87.13
365-345	10	368.32 ± 2.36	1717.89 ± 1.51	13.35 ± 0.14	15.21 ± 0.06	86.67 ± 1.87	84.28 ± 2.16	14.28	85.47

405-365	10	409.12 ± 2.29	2009.13 ± 1.58	15.93 ± 0.11	17.89 ± 0.07	84.25 ± 1.71	82.67 ± 1.91	16.91	83.46
445-405	10	442.34 ± 2.16	2319.10 ± 1.59	17.25 ± 0.10	19.48 ± 0.08	82.13 ± 1.74	80.29 ± 1.94	18.36	81.21
485-445	10	482.47 ± 2.37	2508.78 ± 1.56	19.15 ± 0.13	21.21 ± 0.06	80.78 ± 1.79	78.43 ± 1.86	20.18	79.60

TABLE 2. Values of sums of lengths, weights and ratios of red and white muscles in the studied body regions (R1 and R2) in silver carp *H. molitrix*

Length group (mm)	No. of fish	Total length (mm)	Fish weight (g)	Ratio of red muscle (%)		Ratio of whit muscle (%)		Total ratio Of red Muscle (%)	Total ratio of white muscle (%)
				R1	R2	R1	R2		
345-300	10	329.21 ± 2.15	1418.65 ± 1.59	13.34 ± 0.11	15.53 ± 0.08	86.54 ± 1.74	84.46 ± 2.32	14.43	85.50
365-345	10	368.32 ± 2.36	1717.89 ± 1.51	15.23 ± 0.12	17.96 ± 0.09	84.53 ± 1.83	82.87 ± 2.10	16.59	83.70
405-365	10	409.12 ± 2.29	2009.13 ± 1.58	17.87 ± 0.10	19.45 ± 0.06	82.15 ± 1.78	80.16 ± 1.95	18.66	81.15
445-405	10	442.34 ± 2.16	2319.10 ± 1.59	19.34 ± 0.13	21.12 ± 0.07	80.54 ± 1.72	78.76 ± 1.91	20.23	79.65
485-445	10	482.47 ± 2.37	2508.78 ± 1.56	21.21 ± 0.12	23.24 ± 0.08	78.78 ± 1.71	76.21 ± 1.83	22.18	77.49

TABLE 3. Differences that recorded between the value of total red and white muscle ratios in the mentioned studied types.

Studied Feature	Table (T) value	Calculated (T) value	Significant Level (0.05)
Red muscle ratio (%)	1.15295	0.146393	Significant
White muscle ratio (%)	1.05798	0.165394	Significant

TABLE 4. Differences that recorded between the value of red and white muscle ratios at the studied body areas (r1 and r2) in the mentioned studied types.

Studied Feature	Significant level (0.05)	Table (T) Value	Calculated (T)value	Region
Ratio of red muscle (%)	R1	1.13601	0.14964	Significant
	R2	1.6945	0.143287	Significant
Ratio of white muscle (%)	R1	1.102884	0.156168	Significant
	R2	1.01151	0.175405	Significant

5. DISCUSSION

The results of the current anatomical study shows that the muscle tissue in the current studied fish is composed mainly of two types of motor muscles: the red muscle, which is located directly under the outer skin of the fish in a small area of it, and the white muscle, which is located above the red muscle and it represents the largest part of the muscle tissue, and can be distinguished by color, location, and appearance.These results are consistent with local studies such as study [9] and [10], It was cleared by [11] when studying the fish of carp ordinary and Khashni that the red muscle is located under the skin directly and extended from behind the head to the tail in the form of a thin layer surface . It is characterized by small diameter, containing high percentages of fat, and rich in mitochondria, and animal starch in which is little [12]. The location of the white muscle above the red muscle is occupied by the largest part of the muscle tissue and is characterized by a large diameter containing low percentages of fat, few mitochondria, and a lot of animal starch [13].

The function of the muscles in fish varies according to the type of muscle in them.The red muscle has specialized in long, continuous and slow swimming, while the white muscle has specialized in short, intermittent and fast swimming, in the sudden rush when escaping from predators or when chasing their prey when feeding [14].

The current results showed a significant variation in the rates of ratios between red and white muscles in the two studied areas (R2 and R1) and in the two types studied, where it appeared that the average percentage of red muscle was less than the average percentage of white muscle in both regions and types, and this is consistent with the results of local studies such as study [15] and [16].

The current results showed a sharp difference in the rate of the red muscle ratio according to the studied length group of fish, and here gives us clear evidence that there is continuous growth and this growth increases the rates of the red muscle ratio with the total weight of the fish, which leads us to increase the functional role of the red muscle when swimming fish in their aquatic environment [17].The incremant of the rate of red muscle ratio is mainly the result of the increase in the number of muscle fibers as well as the increase in their size. It is clear to us the increase in activity and speed in large fish compared to small fish [18]. This explains that small fish depend in their early life on the muscles that provide them with the oxygen they need to sustain their metabolic processes such as motor activity for them, and this is before the gills grow in their efficient and good form. In addition, the muscle tissue in fish enables it to determine the level of motor activity according to the rate of the ratio of red and white muscles. More over , the appropriate motor level for the fish can be developed through it [19].

The current results showed that the rate of the percentage of red muscle is clearly different in the two examined areas (R2 , R1) In the two types studied, the rate of the ratio of red muscle in the posterior body area (R2) was higher than the rate of the ratio of red muscle in the anterior body area (R1), and this indicates that the rate of the percentage of red muscle increases towards the posterior body area (tail peduncle). This is due to the importance of this area in terms of motor, which is in conjunction with the tailfin of the common movement organ, that is called the basic organ of movement in the fish. This in turn shows the increase in the ratio of red muscle fiber that is rich in blood and fatty processing. It is the main source of energy processing during the long and continuous motor activity This increase in the ratio of red muscle earns the muscle sufficient muscle flexibility for its fibers, which it needs in its contraction and relaxation, and thus be efficiently for its functional roles appropriate to the movement it needs [20].These results are consistent with local studies such as study[21] and [22].

[23] mentioned that fish families are completely different in the rate of the percentage of red muscle in the muscle tissue. This is related to the nature of their life in the aquatic environment in which they live, that gives a clear picture of their motor activity. The percentage of red muscle in the Scombridae family was (26.1%), which is an active family in movement, while the Squaloidae family reached (14.3%), which is a medium or moderate family of motor activity.On the other hand, the percentage of red muscle in the Chimaeridae family is (0.6%), a family whose motor activity is inert. These different percentages of the rate of red muscle give a clear picture of its motor activity in the aquatic environment in which it lives [24]. From observing the current results, we find that grass and silver carp fish are active fish in movement, because the total rate of red muscle ratio in grass carp fish ranged between (12.34-20.18%), while in silver carp fish ranged between.(%22.18-13.43)

The current results showed that the rate of the percentage of white muscle is clearly different in the two areas studied of the body (R2 , R1) and in the two types studied, the rate of the percentage of white muscle in the front body area (R1) was higher than the rate of the percentage of white muscle in the back body area (R2). This indicates that the rate of the percentage of white muscle decreases towards the posterior body area, and thus it becomes clear that there is an inverse correlation between the rate of the percentage of white muscle and the total longitudinal rate of thickness. This denotes a decrease in the average percentage of white muscle as the total longitudinal rate of thickness increases and towards the posterior body area. These results are consistent with local studies such as [25,26].

The division shown by Mansour [27] on the average ratios of the red and white muscle related to muscle tissue and its characteristics related to appearance for the body of the fish illustrates that grass and silver carp fish fall within the fish Stayers fishes because it contains a high rate of red muscle and it practices swimming in a slow, continuous and long way. The average percentage of fiber to muscle tissue varies between different fish species and it is influenced by a number of important factors including their diet, temperature level, intensity of lighting, and some vital activities such as movement and speed in their aqueous medium [28].

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Arabic Abstract

أجريت هذه الدراسة على نوعين من الأسماك العظمية التي تعيش في المياه العذبة, تم جمع (50) سمكة ذات خمس مجاميع من الأطوال المختلفة, وأوضحت نتائج الدراسة اختلافًا واضحًا في معدل نسب العضلات الحمر والبيض باختلاف المنطقة الجسمية المدروسة ومجموعة الطول المدروسة, فازدادت معدلات نسب العضلات الحمر بازديادمعدل الطول الكلي للسمك كلما اتجهنا باتجاه المنطقة الذيلية للجسم, وهذا ما أثبتته دراسة علاقة الارتباط التي تراوحت قيمة معامل الارتباط فيها (0.993,0.991), وإن معدلات نسب العضلات الحمر الكلية في سمك الكارب العشبي تراوحت بين (12.34-20.18%), وفي سمك الكارب الفضي تراوحت بين (14.43-22.18%), بينما معدلات نسب العضلات البيض الكلية في سمك الكارب العشبي تراوحت بين (87.31-79.60%), وفي سمك الكارب الفضي تراوحت بين (50.85- 77.49%),ولهذا يتضح إن معدلات نسب العضلات البيض تقل بازدياد معدل الطول الكلي للسمك كلما اتجهنا باتجاه المنطقة الذيلية للجسم, وهذا ما أثبتته دراسة علاقة الارتباط التي تراوحت قيمة معامل الارتباط فيها (-0.995 , -0.988), ولوحظ عند التحليل الإحصائي للنتائج لمعرفة الفروقات المسجلة بحساب المعدلات الكلية لنسب العضلات الحمر والبيض,وكذلك معدلاتها ضمن مناطق الجسم المدروسة, وجود اختلافات معنوية ($p<0.05$) في سمك الكارب العشبي والفضي, اعتبر سمك الكارب العشبي والفضي ضمن الأسماك الصامدة؛ لاحتوائها على معدلات نسب عالية من العضلات الحمر وهي تمارس سباحتها بطريقة بطيئة ومستمرة وطويلة, وتعد هذه الدراسة هي الأولى من نوعها محليًا.

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Methods of Control Land Snails "A review"

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P A P E R I N F O

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A B S T R A C T

This article provides a comprehensive review of how to combat land snail species, which are dangerous agricultural pests that threaten the agricultural sector and thus cause huge losses to the economy. The article explains all mechanical, chemical, biological, and even innovative methods, in addition to the development in methods and tools used and followed over time in combating snails. The article shows land snails as agricultural pests , the role of technology in control, the most important species that can be considered dangerous pests that threaten farmers and agriculture in general, and the effects of types of control on the environment and ecosystems. The article also points out the most important difficulties or obstacles facing those in charge of comprehensive control management in applying control.

1. INTRODUCTION

Land snails represent terrestrial molluscs and include a wide range of gastropods, specifically the lungworts. They feed on agricultural crops as their primary and main food. At the same time, they can be considered agricultural pests due to the damage they cause to agricultural crops and the destruction of the ecosystem, as well as the negative effects that result from that. Since ancient times, humans have resorted to inventing ways and means to limit the harm of these organisms and reduce economic and agricultural losses

The most important methods adopted are agricultural control methods, which represent an attempt to modify the agricultural environment to reduce the impact of agricultural pests, including terrestrial snails, such as removing rocks or some unwanted plants that may provide the snails with a place of protection, such as shelters or holes to protect the snails from environmental factors such as or drought. [1,2]. One of the most important methods of agricultural control, especially in the Arab world, is how to manage the agricultural environment and reduce the conditions suitable for pests, including land snails.

For example, controlling the humidity factor, where water is continuously drained from the soil to reduce moisture, which in turn attracts land snails and is one of the most important factors encouraging the spread or removing weeds and harmful plants because they do not provide shelter for snails or use agricultural plant traps, such as planting certain plants to attract snails to this area and not others.Thus, they can be collected and exterminated , Another important method that has been used and been successful is the biological control method, which includes the use of natural enemies as an effective means of getting rid of pests. An example of this is the use of pathogens such as nematodes *Phasmarhabditis*, which infect snails and kill them, or the use of natural enemies such as enhancing the presence of birds and some types of beetles or even the use of fungi, for example, such as mushrooms metarhizium anisopliae, which, if they attack snails, reduce their populations [3-5]. There is another method that has been used for many years, which is chemical control, which includes the use of anti-snail and anti-snail pesticides to get rid of harmful pests, which are snails. There are many chemical substances that have proven effective against snails, including metaldehyde, which is one of the common snail pesticides. However, one of its disadvantages is that it may be toxic to non-target species.For instance, some types of earthworms are beneficial to the soil and other living organisms present in the same environment. Therefore, the use of this pesticide is polluting and harmful to the environment itself. There are other materials, such as the use of iron phosphate, which is a pesticide that is less toxic to non-target species and can be decomposed in the soil into natural components in addition to the

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pesticide methiocarb. Nevertheless, it has negative effects on the environment, which lead to its restricted use.Sometimes, repellent materials are used, such as calcium or magnesium, which are sprayed around plant traps. They have a good effectiveness in repelling snails and thus ground pests. [6-9] .

One of the many ways to combat terrestrial snails as agricultural pests is physical control. The origin of this method relies on manual methods and mechanical methods to prevent the entry of snails or to exterminate them. For example, making traps filled with oils or alcohol, or using materials that attract snails, thus making them easy to collect or collecting them manually.This requires effort from The farmer physically, in addition to choosing the appropriate times to curb them, for example, after rain or collecting at night when they are more active, or using ash or coarse sand around the plants to deter snails and prevent them from entering the farm.This is itself has many drawbacks and disadvantages. [10-13].

All of the above-mentioned methods have multiple disadvantages and drawbacks. Among their disadvantages is that they may harm the entire ecosystem and not just the pest, as in chemical pesticides, or are very expensive, such as physical control, or require effort and time, such as physical ones. Therefore, alternative methods must be used to get rid of land snails, and here a safe alternative one has emerged, which is extracts. Plants, which are used as a wonderful environmental alternative to chemical pesticides or traditional methods of combating land snails. Here, most researches that deal with alternative control focus on the work of these plant extracts, as they contain effective compounds such as essential oils, terpenes, and alkaloids that may be toxic or repel snails and agricultural pests in a way. At the same time, it is less harmful to the environment and reduces risks to humans, animals, and even the affected ecosystem [14].

However, this method of control requires the preparation of plant extracts for what is to be prepared from the plant. It includes multiple methods, for example, infusion, which is soaking the plant parts in warm water to release the active compounds, or the steam distillation method which involves extracting essential oils from plants or preparing the extract with alcohol or solvents, such as soaking in Solvents to extract effective compounds for the purpose of using them as pesticides for control.The methods of applying them are either by spraying which is the process of diluting the extracts with water and spraying them directly on the affected areas or infested plants, or by making baits, which means mixing the extracts with materials that attract snails, such as flour with sticky materials or those with a pungent odor. It attracts snails and distributes them in infected places, thus attracting snails to them, which are similar to traps for them, and getting rid of them. [15-18].

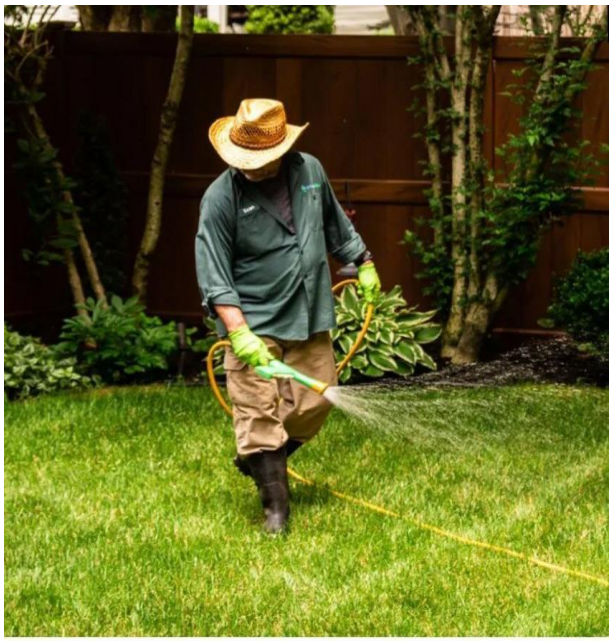

Figure 1. Method of spraying against pests [19]

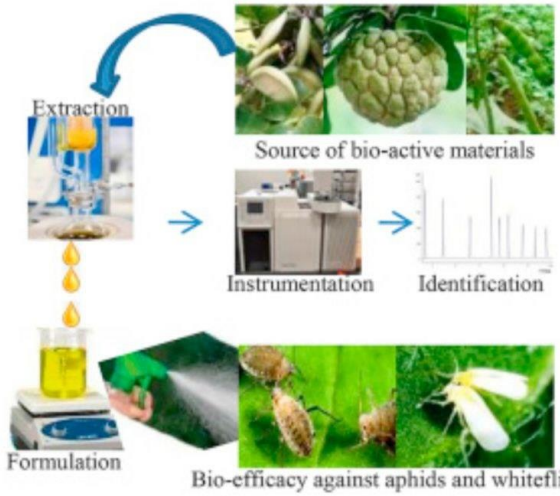

Figure 2. How To convert plants into extracts and use them as pesticides [20]

Many researches have been conducted on this field in the use of some plants and converting them into aqueous or alcoholic extracts, hot or cold, for the purpose of using them as repellent or even lethal pesticides to get rid of agricultural pests. The most important of which are wild snails, but here it must be noted that the overall researches focus on using high concentrations to demonstrate the effect or using plants. It has a pungent smell or prominent taste for the purpose

of attracting these snails, as the sensitivity of the snail species to the extracts differs, and even their sizes, capabilities, and environmental resistance. The most important things that have been used as plant extracts are garlic and allium sativum, which contain the sulfur compounds allicin.They are considered toxic to snails. Here I use garlic cloves [21], or neem *Azadirachta indica* is used. This plant contains azadirachtin, which inhibits the growth and reproduction of snails, as it uses its oils or even aqueous extraction and sprays [22], and hot pepper *Capsicum spp*, which contains capsaicin. It works as a natural snail repellent.

It can be used easily by soaking or boiling it in water and using it by spraying or using it as a spray, as it is considered a natural repellent for land snails [23] or pomegranate *Punica granatum* tannin and polyphenol compounds that act as natural pesticides. An extract from pomegranate peels can be used or prepared and applied directly to snails. Pomegranate peels have general benefits and they are considered a pesticide not only for snails, but for a wide range of different organisms. There is a lot of research that has used types of plants as extracts, such as [24-36].

The development of modern technologies and technology has helped in combating land snails, especially in recent years, to include innovative solutions that combine biological sciences and technology, and in fact have given ideas towards sustainable practices. The purpose of these technologies is to improve and develop the effectiveness of control and thus reduce the impact on the environment. One of the most important technologies is the use of advanced biological control, such as the use of genetically modified nematodes "Phasmarhabditis hermaphrodita" that infect snails and kill them more effectively, or the use of biologically improved bacteria Bacillus thuringiensis genetically improved to provide longer protection. It has a more specific lethal effect on snails, and this technology allows precise control with limited side effects, as well as modern devices and tools made through modern technology. It has contributed to improving control, such as technical applications that combine modern devices and software to improve methods of control and monitoring, such as using robots and drones to monitor and collect snails effectively and significantly. To reduce farmers' effort on large farms, the purpose of this technology is to increase efficiency and reduce the need for intensive manual labor. One of the benefits of technology is the use of smart sensors or monitoring devices connected to programs and applications to analyze data, determine snail groups, and send instant notifications. [37-46].

It is one of the most widespread types of land snails that are considered agricultural pests and cause losses and obstacles to plants and their growth in particular, economic and agricultural losses, and environmental problems in general, such as the brown snail (Cornu aspersum). Its original home is the Mediterranean regions, but now it has spread globally in most regions and countries and It feeds on agricultural crops, fruits, strawberries, and citrus, and causes serious damage, as does the giant African conch (Achatina fulica).

It is characterized by its large and gigantic size, as well as its great speed in environmental adaptation. Its original homeland is East Africa, but now it has begun to spread throughout the world. The large gray snail (Deroceras reticulatum), whose original homeland is Western Europe, is known for its gray-brown color. It feeds on vegetables, legumes, and other snails such as the striped snail (Theba pisana). Which affects crops such as wheat, barley, and the Spanish cockle (Arion vulgaris), in addition to the pea cockle (Monacha obstructa [47-51].

Methods of controlling pests, especially land snails, have developed widely over time, as there were transitional stages between traditional methods and modern technologies. This transitional stage included .It is a combination of the past and its traditional methods and the present with its technology and modern techniques.[52-54].

The control process faces a series of challenges as well as difficulties, as they may affect the effectiveness of the strategies used to get rid of land snails. These challenges include many factors, including biological ones. The development of resistance in snails and the speed of adaptation in snails may reduce the effect of biological methods and products used in control. Environmental: Variation in environmental conditions (humidity, temperature, and soil) affects the effectiveness of different control methods, so the response will be different., Economical, high costs in implementation and development, which causes financial losses. There are challenges such as regulations, regulations and laws that hinder development, new programs and tests, and finally the lack of research, sources and studies on the subject of pests in general and snail pests in particular [55-61].

3. CONCLUSIONS

Combating land snails as agricultural pests includes multiple methods, but each of these methods has its advantages and disadvantages, but in general, most of the methods bear fruit, but in varying proportions. Therefore, those interested in the field of pest control must follow up and pay attention to some of the matters that contribute to controlling this type of pest, such as modifying habitats to reduce Moisture through proper field drainage or the removal of holes or some debris can make environments less suitable for snails. Encouraging the presence of natural predators such as birds, beetles and some nematodes can help control snail populations.

The use of chemical agents such as metaldehyde or pesticides in general can be effective but must be used wisely to avoid environmental damage. Using baits and traps is a good method because it targets snails directly without causing any harm to the environment. The most important thing that can be recommended is Integrated Pest Management (IPM), which represents a combination of all the above-mentioned methods. The use of a group of cultural, biological, chemical and physical methods that represent part of a strategy. Comprehensive pest management is the most effective and sustainableapproach. Continuous monitoring and continuous modification of methods and techniques as needed contribute to controlling pests while reducing environmental impact.

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Arabic Abstract

يقدم هذا المقال البحثي مراجعة شاملة لكيفية مكافحة أنواع القواقع البرية، وهي من الآفات الزراعية الخطيرة التي تهدد القطاع الزراعي وبالتالي تسبب خسائر فادحة للاقتصاد. يشرح المقال جميع طرق المكافحة الميكانيكية والكيميائية والبيولوجية وحتى المبتكرة، بالإضافة إلى التطور في والأساليب والأدوات المستخدمة والمتبعة على مر الزمن في مكافحة القواقع. القواقع البرية كآفات زراعية وأيضا دور التكنولوجيا في المكافحة، بالإضافة إلى أهم الأنواع التي يمكن اعتبارها آفات خطيرة تهدد المزارعين والزراعة بشكل عام، وتأثيرات أنواع المكافحة على البيئة والنظم البيئية. كما يشير المقال إلى أهم الصعوبات أو المعوقات التي تواجه القائمين على إدارة المكافحة الشاملة وتطبيقها.

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A Study of the Protective Efficacy of Spirulina Algae Powder Against Biochemical Changes in Rats Treated with Cadmium Chloride

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A B S T R A C T

The current study investigates ithe protective role of *Spirulina platensis* algae powder against oxidative stress caused by exposure to cadmium chloride in laboratory white rats Rattus norvegicus. The study was conducted from May (2023) to April (2024) at the University of Karbala / College of Education for Pure Sciences / Department of Biology. In this experiment (18) rats, Weighed (190-230g) with Age range of Fourteen weeks were divided systematically into three groups (6 for each). The first group was considered a negative control, where water and fodder were given freely. The second group (G2) was considered a positive control, treated withan aqueous solution of cadmium chloride at a dose of 1 mg/kg of body weight. The third group (G3) was considered a protective group, where Spirulina algae powder was given in does of 177 mg/kg. After three hours, it was given Cadmium chloride solution. At the end of the experimental period (30 days), the animals were anesthetized with chloroform in the closed method, then take blood from their heart and then stored until blood and biochemical parameter were performed.

The results of the current study showed that oral administration of cadmium chloride solution for 30 days to group (G2) led to a morale boost at the level ($P < 0.05$) in the liver enzymes level (ALP, ALT, (AST) as well as urea, creatinine, and blood electrolytes (K.Ca, Na). A decrease in the level (GSH), (CAT) and (SOD) was observed when compared to the (G1). As for the preventive role, the results showed that dosing the animals with Spirulina algae powder for a period of three hours before giving the animals the aqueous solution of cadmium chloride contributed to changing the aforementioned results by reducing the toxic effect of the cadmium chloride solution, as a significant decrease was observed at the level ($P < 0.05$) in the Liver enzymes level and kidney parameters when compared with (G2), and (G1). Antioxidant enzymes (GSH, SOD, CAT) increased in the above groups.

1. INTRODUCTION

The medicinal plants have occupied a large place in the medical sciences and pharmacy, have become a Safe basis for pharmaceutical materials of the current century. Recent studies have indicated the effect of medicinal plants as antioxidants as an alternative to drugs and chemical treatments. Modern scientific researches have also proven the pharmaceutical effectiveness of many compounds derived from plant sources that have antioxidant properties. This has made them occupy a large place in the field of medical treatment for many diseases that affect the physiological activity of humans and animals alike [1].

Spirulina algae is one of the plants that has been used in the treatment of many diseases. It has a positive effect on the body as it has received widespread attention from many researchers and scientists in addition to containing high concentrations of proteins and vitamins, especially vitamin B12. More over, it contains minerals, amino acids, polyunsaturated fatty acids, and biologically active components, including phycocyanin, beta-carotene, and phenolic compounds, which provide anti-inflammatory activity and antioxidant efficacy [2].

On the other hand, heavy elements are considered among the most dangerous chemical compounds that all living organisms are exposed to in the environment, including cadmium chloride, as its density is five times greater than the density of water. This makes it a cause of harm to the body, especially the kidneys since it causes tissue damage by disrupting the function of the renal tubules and failure of the natural absorption process of materials, thus reducing the process of phosphate absorption that occurs in the renal tubules, and then kidney failure occurs, as the kidneys contribute

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to the excretion of toxic waste, in addition to its effect on the liver, which constitutes an important site in the body as it plays a role in the processes of Biotransformation [3].

The rate of cadmium transfer from the liver to the kidney depends on the rate of formation of the cadmium-metallothionein (MT-Cd) complex in the liver. When the complex reaches the renal tubules, it is analyzed by lysosomes, which contain digestive enzymes that release cadmium. This in turn leads to the production of renal metallothionein, causing it to accumulate in the kidney at higher levels than in the liver. Since its free period in the kidney is long, it may reach 3 months, compared to the half-life of the MT-Cd complex, which reaches (only 4-3 days), which makes it harmful to the kidney and causes tissue damage in the tissue kidney [4].

The continuous increase in the concentration of heavy elements in the environment from its various sources was accompanied by the occurrence of many diseases, which made it a source of concern for all living organisms, especially humans, which was accompanied by the use of many medications to get rid of the symptoms of these diseases. Over time, the use of these medications became a major cause of many health problems, which are classified as side effects of using these medications. This prompted many researchers to find alternative methods to reduce the use of these medications by using alternative treatments that do not cause harm to the body. Thus, the present study aims at: Studying the protective role of Spirulina algae powder in reducing the renal toxic effects resulting from exposure to high concentrations of cadmium chloride. This is achieved by examining the changes occurr in the tissue structure of the kidney as the center for ridding the body of toxic wastes to which exposes the body to harm.

2. MATERIALS AND METHODS

male white laboratory rats, *Rattus norvegicus*, weighed between 190-330 grams and were aged Fourteen (we). They were btained from the animal house of the College of Pharmacy - University of Karbala. The experiment lasted from September 22 to January 15 of the academic year 2024. The animals Placed in boxes with mesh lids to adapt rats. The floor of the cages was covered with sawdust, taking into account changing it from time to time to maintain its cleanliness. The animals were given water and fodder freely, under suitable ventilation conditions, at a temperature of (25°C) and natural lighting, and were left to adapt to the experimental conditions for two weeks.

2.1. Experiment Design

After the acclimatization period for the animals ended, they were classified into three groups, with (6) animals for each group, as follows:

1-The first group (G1): The animals of this group were considered negative control and were given water and feed freely

2-The second group (G2): The animals of this group were considered positive control as they were dosed daily with cadmium chloride at a concentration of 1 mg/kg for (30) days [5].

3-The Third group (G3): The animals of this group were a preventive group. The animals were dosed daily with cadmium chloride at a concentration of (1) gram/kg of body weight, and after three hours they were dosed with spirulina powder at a concentration of 177 mg/kg of body weight for a period of (30) days [6].

2.2. Collection Blood

At the end of the experiment, the rats were anesthetized using the closed method, which included placing the animals in a tightly sealed container, noting that a cotton ball containing chloroform was placed inside the container. After a few minutes, the animal was anesthetized. Then, blood get directly from heart using a sterile medical syringe with a capacity of (5) ml. Then, the blood in test tubes was put .After that, the tubes were transferred to the centrifuge at a speed of (3000) rpm for (15) minutes in order to obtain the serum, which was transferred to small, clean, dry, and marked Eppendorf tube plastic tubes. The serum was kept in the refrigerator until blood and biochemical tests were performed.

3. RESULTS AND DISCUSSION

3.1. Effect of treatment with Cadmium Chloride Solution on Liver Enzyme Levels (AST, ALP, ALT)

Table 1 an increase was noted at ($P<0.05$) in the concentration of liver parameter (ALT, AST, ALP) in (G2) when compared with the negative control group (G1).This is due to damage in the liver tissue of animals treated with cadmium chloride because of its toxicity to the body. Our results were consistent with the study of Kang [7] who noted a significant increase in liver parameter levels exposed to cadmium chloride directly or indirectly through the accumulation of toxins in the body for long periods, which leads more in the levels of these parameter such as AST, ALP, ALT as a result of tissue damage in the liver .

These results confirm the results of the researchers [8] Asagba & Eriyamremu in their study where the animals were given (10) mg of cadmium chloride / kg of body

weight for 16 weeks. They noticed a significant increase on concentration of liver enzymes AST, ALT and ALP compared to the (G1) that received water and fodder freely. They explained that the cadmium chloride solution caused atrophy of the liver cells in the treated animals as a result of the liver poisoning that caused the destruction of the tissue of the cells which make up the liver and the release of larger quantities of these enzymes. However, the study did not match the study Wielgus-Serafińska *et al*. (9) which showed a decrease in the activity of various enzymes in the liver of mice after exposure to cadmium chloride solution, indicating liver damage.

TABLE 1. Shows the Level of Liver Parameter on Study Groups

Tretments	Means ± stander err		
	ALP	ALT	AST
Negative control group G1))	133.66± 0.34 C	24.95± 0.66 D	91.00± 0.19 C
Positive control group (G2)	176.48 ±1.70 A	44.14± 2.29 A	226.51± 9.33 A
Protective group (G3)	139.69 ±0.27 B	31.95± 0.64 C	118.17± 2.41 B
LSD	2.607	3.7406	14.223
P(value)	0.05	0.05	0.05

3.2. Effect of treatment with spirulina and cadmium chloride on the concentration of liver enzymes (AST, ALP, ALT)

The study showed in Table (1) that there was a more difference At (P<0.05) in enzyme parameters (ALT, AST, ALP) when comparing the (G2) with (G3) .The level of these parameter decreased in the (G3) group but the concentration these enzymes would l not decrease to return to normal concentrations in the (G1) group.

The study agreed with study conducted by Ibrahim et al [10] .It showed that animals treated with spirulina and cadmium chloride had a decrease in the level of liver parameter compared to those (G2), as spirulina powder contributed significantly to reducing the concentration of parameter ALT, ALP and AST by reducing the oxidative stress caused by the cadmium chloride solution on the body It contributes to the destruction of liver tissue and the release of free radicals that can destroy the roots of liver cells and thus release high concentrations of the enzyme in the blood. The study differed from the outcome of other studies conducted by researchers Damessa et al. [11], as liver enzymes did not show any decrease in animals treated with spirulina and cadmium chloride solution compared with animals treated with cadmium alone. This is related to the destruction of liver tissue and the inability of spirulina powder to rebuild the tissue, especially after a long period of treatment with cadmium.

3.3.The Effect of Treatment with Spirulina and Cadmium Chloride on the Concentration of Oxidation Enzymes (MDA, SOD, CAT, GSH)

The study in Table 2, showed a significant increase at (P<0.05) in level of antioxidant parameter (SOD, CAT, GSH)in the (G3) when compared with the (G2), accompanied by a non-significant decrease in the concentration (MDA) in the preventive group when compared with the positive control group, noting that these concentrations returned as close as possible to the normal state in the negative control group.

TABLE 2 . Shows level of antioxidant parameter in the study groups

Treatments	Means ± stander err			
	MDA	CAT	SOD	GSH
Negative control group G1)(	0.32±2 2.90 B	3.88±33.58 C	3.41±36.94 C	3.15±44.72 A
Positive control group (G2)	0.55±2 5.37 A	1.32±50.76 A	1.01±67.59 A	1.00±38.04 C
Protective group (G3)	0.36±2 1.51 C	3.94±40.17 B	3.02±59.49 B	3.54±43.30 AB
LSD	1.1291	7.5446	2.3907	2.6096
P(value)	0.05	0.05	0.05	0.05

The results of the current study were consistent with the results of the study by Candelaria et al. [12], where they observed an increase in the oxidation enzymes SOD, CAT, and GSH in the group fed on spirulina, accompanied by a decrease in the level of the MDA enzyme, as spirulina, which contains pigments, carotenoids, xanthophyll, vitamins, minerals, and other nutrients, caused a decrease in MDA and reduced the severity of cadmium toxicity within the body tissues .

In the same direction, the study agreed with Ibrahim et al.'s study [10], which showed an increase in the level of oxidation enzymes in the (G3) fed on spirulina and cadmium chloride, and that this increase came as a result of the role of spirulina in maintaining the body's tissues. This is because it contains important elements, including vitamins with high nutritional value, which help the body to curb the toxic effects resulting from exposure to cadmium chloride solution. At the same time, they contribute to raising the concentration of antioxidant enzymes and also reducing the concentration of the MDA enzyme.

3.4. The Treatment with Cadmium Chloride Influence on the Level of Kidney Standards (Na, Ca, K, urea, crea)

The study showed in Table (3), a significant increase at the (P<0.05) in the level of kidney standards (Na, Ca, K, urea, crea) in group (G2) compared with G1. The study was consistent with the results of Ogham etal. [13] who noted a significant increase at (P<0.05) in the standards of kidney parameters (creatinine, urea, K, CA, Na) for animals fed cadmium chloride compared to the normal group, as exposure of the body to high concentrations of cadmium chloride solution causes damage to kidney tissue and thus kidney failure.

Moreover, the study by Karami et al. [14] indicated that cadmium chloride caused an increase in kidney parameters, including (Na, Ca, K, urea, crea), which caused kidney dysfunction by delaying absorption and kidney tissue damage.

In the same direction, the study agreed with the study of Yan & Allen [15], where they observed an increase in the level of (Na, Ca, K, urea, crea) in animal models exposed to cadmium as a result of damage to some components of the renal unit, as cadmium causes a general defect in the epithelial cells lining the proximal convoluted tubule. This causes an increase in the secretion of renal electrolytes into the blood. The results of the current study differed from the study by Cui et al. [16], where they observed a decrease in the concentration of renal parameters, including Ca, K, and Na, as cadmium chloride caused damage to kidney tissue, represented by atrophy of the renal glomerulus and destruction of the cells lining the renal tubules, accompanied by damage to the mitochondrial membranes.

3.5. The effect of Treatment with Spirulina and Cadmium Chloride on the Concentration Of Kidney Parameters (Na, Ca, K, urea, crea)

The study Table 3 showed a significant drop at the level (P<0.05) in the concentration of kidney parameters (Na, Ca, K, urea, crea) in the preventive group (G3) that was given spirulina powder and cadmium chloride solution when compared with the positive control group (G2) that was given cadmium chloride solution only.

The results of the current study agreed with the results of the study of Ibrahim et al. [10] who observed a decrease in the level of kidney parameters in the group dosed with a solution on cadmium chloride and spirulina for 28 days and interpreted this as spirulina reducing the toxic effect of cadmium chloride as it provides lines of defense for the body and limits damage to kidney tissue. The results of the current study confirm the results of the study by Berbesh et al. [17] who used Spirulina platensis algae against toxicity caused by giving cadmium chloride solution to chickens. 45 chickens were randomly divided into three equal groups, 15 chickens for each group. The first group received water samples and several negative control groups, while the second group received a dose of cadmium chloride solution and was considered a positive control group, while the third group received a dose of cadmium chloride solution and spirulina and was considered a preventive group. The study showed that chickens dosed of cadmium chloride solution decreased significantly in weight, in addition to the deaths of many members of the group, while the members of the group that received a dose of cadmium chloride solution in addition to spirulina powder achieved a significant improvement in growth parameters, which included an improvement in final body weight and daily weight gain, in addition to a significant decrease in kidney physiological parameters. In the same direction, the results of the current study agreed with the results of the study of Gaurav et al. [18] who used spirulina and cadmium chloride, where the effect of giving cadmium chloride solution to mice for 30 days was studied. The experimental animals received cadmium chloride solution at a level of 2 mg/kg of body weight, while the animals of the second group were treated by giving them cadmium chloride solution simultaneously with spirulina powder for 30 days. It was observed that kidney function was restored to normal levels in the second group compared with mice exposed to cadmium chloride in the first group.

TABLE 3. Shows The Standard of Kidney Function in The Study Groups

Treatments	Means ± stander err Urea	Creatinin	Na	K	ca
Negative control group G1)(	0.29± 31.45 B	0.04 ± 0.82 B	1.30± 165.33 B	0.08± 3.38 B	0.13± 11.48 B
Positive control group (G2)	0.39± 41.31 A	0.15± 1.52 A	3.90± 185.67 A	0.13±2.4 6 C	0.35±1 2.88 A
Protective group (G3)	0.39 ±29.95 C	0.01±0.9 4 B	0.65 ± 163.17 B	0.15 ±3.43 B	0.29±1 0.33 D
LSD	0.9824	0.2377	6.4266	0.3617	0.7412
P(value)	0.05	0.05	0.05	0.05	0.05

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Arabic Abstract

تهدف الدراسة الحالية الى معرفة الدور الوقائي لمسحوق طحالب السبيرولينا بلاتينسز ضد الجهد التأكسدي الناتج عن التعرض لكلوريد الكادميوم في الجرذان المختبرية البيضاء. اجريت هذه الدراسة خلال شهر مايو 2023 الى شهر ابريل 2024 في جامعة كربلاء \ كلية التربية للعلوم الصرفة \ قسم علوم الحياة.

في هذه التجربة، 18 جرذ تتراوح اوزانهم بين (190- 230) غرام بمعدل عمر اربعه عشر اسبوع . قسمت نظاميا الى ثلاث مجاميع (ستة في كل مجموعه). حيث تعتبر المجموعة الاولى هي مجموعه السيطرة السالبة و التي اعطيت الماء و العلف فقط. المجموعة الثانية والتي تعتبر مجموعة سيطرة موجبة والتي عوملت بالمحلول المائي لكلوريد الكادميوم بجرعة و التي عوملت بالمحلول المائي لكلوريد الكادميوم بجرعة 1 غم\كغم من وزن الجسم. اما المجموعة الثالثة والتي تعتبر المجموعة الوقائية حيث عوملت بمسحوق طحالب السبيرولينا و بعد ثلاث ساعات اعطيت محلول كلوريد الكادميوم. بعد انتهاء مدة التجربة (30 يوماً) تم تخدير الحيوانات بمادة الكلوروفورم بطريقة مغلقة، بعدها تم جمع الدم و خزنت لحين اتمام التحاليل البايوكيميائية.

اشارت نتائج الدراسة الحالية الى ان التجريع الفموي لمحلول كلوريد الكادميوم لمدة 30 يوماً للمجموعة الثانية ادى الى زيادة معنوية عند مستوى ($P > 0.01$) في مستوى انزيمات الكبد (AST, ALT, ALP) و كذلك اليوريا , الكرياتنين و الكتروليات الدم .(K ,Ca, Na) , بينما ظهر انخفاض في مستويات (GSH) و (CAT) و (SOD) عند مقارنتها بالمجموعة الاولى .

كدور وقائي اظهرت النتائج ان تجريع الحيوانات بمسحوق طحالب السبيرولينا لمدة ثلاث ساعات قبل اعطاء المحلول المائي لكلوريد الكادميوم ساهم في تغيير النتائج المذكورة عن طريق تقليل التأثير السمي لمحلول كلوريد الكادميوم، حيث لوحظ انخفاض ملحوظ عند مستوى ($P > 0.05$) في مستويات انزيمات الكبد و معايير الكلى عندما تم مقارنتها مع المجموعة الثانية و الثالثة، وارتفعت كذلك الانزيمات المضادة للأكسدة (GSH, SOD, CAT) في المجموعة المذكورة.

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Molecular Identification of the Fusarium Verticillioides Isolated from Corn Grains from Karbala Province

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A B S T R A C T

Cereals are an important source of nutrition for both people and their domestic animals. Whether in the field or in storage, these grains are sensitive to fungus infestation . Fusarium verticillioides is the most important one. The results of this study showed that this species was present in all grain samples obtained from diverse locations . By doubling the region of F. verticillioides, the study revealed the molecular diagnosis. The polymerase chain reaction (PCR) technology was used. The results of the molecular analysis showed that this strain was diagnosed for the first time in Iraq, as the results of the comparison of the sequence of the nitrogenous bases of isolate No. 1 showed that it was 99% identical to the isolate registered in Australia under ID: KP132240.1, which belonged to the type F. verticillioides. The results of the alignment also showed that there was a discrepancy at position 390, as the nitrogenous base Guanine was recorded in the sequences of the isolate under study instead of the Adenine nitrogenous base (A\G) and this variation was of the type of Transition (equivalent substitution). Transmutation of the two laws is of the non-equivalent substitution type Transvertion, and that this type was registered under the accession number DI: OP056029.

1. INTRODUCTION

Corn grain is one of the important grain crops in Iraq and the world. Its importance comes through its multiple use as it enters the human diet directly or indirectly, through its use as a basic ingredient in the animal feed (Al-Aswadi, 2002).. Many plant pathogens are spread via seeds, which can result in significant crop losses. Increased examination of grain quality has resulted from recent increases in grain production and sale, with specific focus on worries about contamination with grain-borne diseases such as bacteria, fungus, and viruses that existing on the surface or inside the grain and have the ability to spread. Grains are being harmed, especially with the availability of favorable conditions. [1]

Fungi are a broad group of microorganisms that exist in a variety of environments, including soil, plant parts leaves, roots, fruits, and seeds, water, and food [2,3]. seeds are the main source for the presence of fungi, as the various types of cereals are exposed to fungal infections, whether in the field, during harvesting, or during transportation and storage. The fungal species belonging to the genera Aspergillus , Penicillium and Fusarium are the most common in causing these infections. [4] The safety of food and feed and the freedom from fungi and their toxins is one of the necessary matters that must be focused on , and the danger of many fungi and mycotoxins and their dangerous effects require accurate diagnosis of the fungal species that produce these toxins [5-14].

Mycologists have traditionally used morphological diagnosis based on phenotypic characteristics such as spores formed as a result of mitotic or asexual division or sexual reproduction (meiosis) to identify fungal species [15] .It is still used today as a method of identifying species within fungal groups, despite the use of morphology. It is very important to understand the evolution of phenotypic traits in fungal species, but it requires technical expertise, an experienced specialist, and a long time, especially with less common species [16,17].

In contrast to morphological and biochemical diagnostic tests employed in the laboratory diagnosis of fungi, molecular diagnostics exhibited great accuracy, speed, effort, and specificity in distinguishing between species and sub-species of fungi (Liu et al., 2000). Fungal DNA extraction-based molecular diagnostic tools give a unique barcode for identifying and characterizing various fungal isolates up to the species level [18] .The goal of this study

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was to extract F. verticillioides from seeds and diagnose it using phenotypic, microscopic, and molecular methods.

2. MATERIALS AND METHODS

Fifteen samples have been collected from yellow corn seeds at a rate of 2 kg from markets Karbala Governorate, to isolate the toxin- producing fungi. The samples were transferred to the advanced mycology laboratory / College of Education for Girls / Department of Biology / University of Kerbala. for diagnosis and study. A. Culture media The culture media for Potato Dextrose Agar (PDA) has prepared as recommended by the Manufacturing company and sterilized by Autoclave at 121 C° in 15 minutes for 15pis \ inch2.This method has been used to isolate and grow the fungi B. F. verticillioides is isolated and identified.

The researcher utilized the method used by [19] to isolate Fusarium from seeds, in which 25 seeds were randomly selected from each replicate of each sample and sterilized for two minutes with sodium hypochloride at a concentration of 10 % of the commercial preparation.The seeds were washed three times with distilled water to remove any remaining chlorine from samples , dried on filter paper, and then transferred to 9 cm diameter Petri dishes containing PDA culture medium with five seeds per plate .The plates were incubated in the incubator at a temperature of 25 ± 2 °C for 5 days. Then different fungi were purified, and Fusarium species were planted on the same PDA medium and incubated at 25 °C for a week, after which the fungal isolates were diagnosed using diagnostic keys [20,21]. C.Molecular identification of F. verticillioides isolates.

2.1. DNA was extracted from isolates of the fusarium

Isolates were cultivated on PDA culture medium and then incubated for 5-7 days at 25 ± 2 C°. The DNA was extracted and purified using a Promega Wizard® Genomic DNA Purification Kit and by following the DNA extraction protocols provided in the kit.

2.2. A Gel of agarose was made

According to [22] 1.5 g of agarose was dissolved in 100 ml of the previously prepared TBE solution to make a 1.5 percent agarose gel. To identify DNA fragments, the agarose is heated to a boil and then cooled to 45-50 C°. After cooling, Red Safe dye is add. The gel was poured into the casting plate where the agarose support plate was formed after the comb was fixed to produce holes that would contain the samples. Allow to (30) minutes to cool after pouring the gel slowly to avoid air bubbles. After the comb is carefully raised from the hard agarose, the board is fastened to its holder in the horizontal unit of the electrical relay, which is represented by the tank used for the electrical relay. The gel is coated with a TBE solution , which is put into the tank

.

2.3. Sample Preparation

For electrophoresis, 31 of loading solution (Intron/Korea) was combined with 5 l of DNA extracted as described in section 3-4-6-1. Then, for 1-2 hours, administer a 7 Vc2 electric current until the dye reaches the other side of the gel. A UV source with a 336 nm dimension was used to evaluate the gel.

2.4. The purity and concentration of DNA are determined

A Spectrophotometer (Nanodrope) was employed for this purpose, and the values of DNA concentration and purity were recorded at wavelengths 260 and 280 after calibrating the instrument with a small drop of 0.71 of DNA extract and zeroing it with a corresponding drop of elution buffer solution . Prefixes used in the reaction. The initiators were diluted with distilled water to obtain a concentration of 100 picomoles , the required concentration was prepared by taking 10 liters of the original solution and completing the volume to 100 liters by adding double distilled water to make it ready for use, according to the attached leaflet from the supplying company . The forward ITS-1 starter and the reverse ITS-4 starter, both supplied by IDT (Integrated DNA Technologies, Canada), were utilized in this work as stated in Table 1. [23]

TABLE 1. The purity and concentration of DNA aredetermined

Prim.	Seque.	Tm (°C)	GC (%)	Prod.size
F.	5′-TCCGTAGGTGAACCTGCGG -3′	60.3	50 %	550 bp
R.	5′ TCCTCCGCTTATTGATATGC-3′	57.8	41 %	

2.5. PCR (Polymerase Chain Reaction)

Using the ITS-1 primer with ITS-4, a PCR approach was utilized to amplify the ITS region. A total volume of 25 l was used for PCR amplification, which included 1.5 l of DNA, 5 l of Taq PCR PreMix, and 1 l of each primer (10 pmol). A total of 25 l of distilled water was supplied to the tube.

3. RESULTS AND DISCUSSION

A. DNA extraction from F. verticillioides isolates. The results of the DNA extraction study revealed that the isolate under study was isolated from pure *Fusarium* cultures on PDA medium.presence of DNA in the selected isolates for molecular study was confirmed by electrophoresis on agarose gel at a

concentration of 1.5 percent and at 5 ml/cm for 1 hour; as the bands appeared on the agarose gel, which means the presence of DNA, they reached a purity of 1.9 and a concentration of 76.2 Electrophoresis of PCR replication products

The results of the duplication of ITS1 and ITS4 regions located between rDNA genes using forward and reverse primers of ITS1-ITS4 primers of the species in question. The replication results by the polymerase chain reaction (PCR) technique using specific primers and electrophoresis of the replication products showed the appearance of bands at approximately 550 bp (compared to DNA 1000 plus), which indicates the correlation of the primers and the occurrence of doubling Figure 1.

According to the foregoing results of the molecular analysis using the primers ITS1 and ITS4 to multiply the ITS region using PCR technique, it has been proven that the use of molecular technology has a major role in the accurate diagnosis of fungal species and may be an alternative or complementary to phenotypic diagnosis, and this was confirmed by studies that the use of molecular techniques supports morphological diagnosis through To provide a quick and dependable test for species identification and classification;For plant pathogenic fungi, the first and most difficult step to identify is the determination of morphological and agronomic characteristics, and this is exactly the case with *Fusarium* spp. Because of the difficulty of distinguishing and different between species and their overlapping and their participation in many phenotypic and microscopic characteristics, therefore, molecular technology must be relied upon for accurate diagnosis [24-26]. According to [27] also reported that PCR can be used to identify *Fusarium spp*. , either as an alternative or as a supplement to morphological identification methods. And Molecular diagnostic methods also provide faster and higher accuracy and sensitivity; The correct and rapid diagnosis of the agent being studied is necessary to implement the appropriate treatment, which, if done correctly, helps reduce injuries and the risks of those injuries [28].

The presence of the ITS region in the diagnostic has been the reason for its use. According to [29], the ITS region offers the following benefits: (1). All organisms have several copies of the ribosomal gene, allowing for sensitive PCR detection. (2) The ITS region contains a highly conserved and variable area, which allows for target identification and the construction of PCR primers. It's also because the ITS region is a non-coding area that's extremely polymorphic and contains enough taxonomic units. As a result, the sequences can be separated down to the species level, with results ranging from (450 to 750) base pairs [30].

Figure 1. Electrophoresis of the PCR doubling products using primers ITS1 and ITS4 *F. verticillioides* on a (2)% agarose gel at (5) V for (1.5) hours and the appearance of the bands at ~550 bp compared with the DNA ladder (1000 plus

Figure 2. In BLAST, the sequence of nitrogenous bases of isolate No. (4) under investigation and the nearest isolate of *F. verticillioides* found in Iran under accession ID: KP132240.1were aligned. The selection in red highlights the regions of variation, and the proportion of congruence is 99 percent.

Figure 3. A phylogenetic tree was constructed using the BLAST tool and the Neighbor Joining option for Isolate of *F. verticillioides* under study, and the global isolates registered in the NCBI Gene Bank.

Figure 4. The registration form for the isolate F. verticillioides at the National Center for Biotechnology Information (NCBI) shows the identification number, the name of the fungus, the names of researchers, and the sequence of nitrogenous bases.

4. CONCLUSIONS AND FUTURE

The results showed that fungal infections in yellow corn seeds were caused by fungi, especially the mold studied. The results also showed that molecular diagnosis of fungi is indispensable, as it is a complementary method to the phenotypic diagnosis, and is the means that leads to reassurance of accurate diagnosis.

5. APPLICATIONS

Molecular diagnosis based on DNA barcode extraction of fungi is through which fungal isolates are identified and characterized up to the species level. Through this study, the fungus F. verticillioides is extracted and it is possible to work on biological, chemical or physical control of the fungus by taking appropriate precautions.

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Arabic Abstract

الحبوب هي مصدر مهم للتغذية لكل من الناس وحيواناتهم الأليفة. سواء في الحقل أو في المخزن، هذه الحبوب حساسة للإصابة بالفطريات. ومن أهمها فطر Fusarium verticillioides، وأظهرت نتائج هذه الدراسة وجود هذا النوع في جميع عينات الحبوب التي تم الحصول عليها من مواقع مختلفة. ومن خلال مضاعفة منطقة F. verticillioides، كشفت الدراسة عن استخدام تقنية التشخيص الجزيئي لتفاعل البوليميراز المتسلسل (PCR). وبينت نتائج التحليل الجزيئي انه تم تشخيص هذه السلالة لاول مرة في العراق، كما اظهرت نتائج مقارنة تسلسل القواعد النتروجينية للعزلة رقم 1 مطابقتها للعزلة المسجلة في استراليا بنسبة 99%. تحت المعرف: KP132240.1، الذي ينتمي إلى النوع F. verticillioides. كما أظهرت نتائج المحاذاة وجود تباين عند الموضع 390 حيث تم تسجيل القاعدة الآزوتية Guanine في تتابعات العزلة قيد الدراسة بدلاً من القاعدة الأدينينية (A\G) وكان هذا التباين من نوع الانتقال (استبدال يعادل). تحويل القانونين هو من نوع الإحلال غير المتكافئ Transvertion، وأن هذا النوع تم تسجيله تحت رقم الانضمام DI:OP056029.

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Results on Almost Nonexpansive Mappings in 2-Normed Spaces

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A B S T R A C T

The spaces of 2-normed and quasi 2-normed have been called to achieve the purpose of this article. Here, a novel mappings class is presented as non-expansive in quasi2-normed spaces. The properties of mappings class are elaborated in this study. The results of fixed point mappings are proved.

1. INTRODUCTION

Gähler (see, [1]) constructed the concepts of two (normed and Banach) spaces theories. These concepts are derived from the idea of area in 2-dimensional Euclidean space [2-3]. The theory of fixed point is crucial subject in developing functional investigation. Besides, it's utilized significantly in several branches sciences. So have subsequently been studied by many mathematicians in these spaces. Recently, Rumlawang [4] derived a norm from the 2-norm to demonstrate the theory of fixed point which is provided studying approach and the sequences of Cauchy, as well as, the contractional of mappings in the spaces of 2-normed. Anjum and Abbas [5] proved partially the theorems of fixed point as extending the outcomes by Berinde and Pacurar [6] in terms of 2-norm spaces. Harikrishnan and al.et [7] presented the two kind convergence (strong and weak) in 2-probabilistic normed spaces to be strongly or weakly bounded. The branch of fixed point theory includes a wide area of work that can be studied in current spaces as in [8-9] and its references. In this paper, some requirements are presented to prove fixed point results in quasi 2-normed spaces.

Definition 1.1: [1] assume H is dimension in a real linear space > 1 and $\|.,.\|: H \times H \to R$ satisfying the following:–

$(2N_1)$ $\|n,m\| = 0 \Leftrightarrow n$ *and* m are linearly dependent in H

$(2N_2)$ $\|n,m\| = \|m,n\|$, for all $n, m \in H$

$(2N_3)$ $\|n, \alpha m\| = |\alpha| \, \|n,m\|$ for every real number α

$(2N_4)$ $\|n+m,h\| \le \|n,h\| + \|m,h\|$ for all $n, m, w \in H$

Then the twosome $(H, \|.,.\|)$ is named 2-norm linear space.

Herein, a 2– norm $\|n,m\|$ is good enough

$\|m+\alpha n, n\| = \|m,n\|$ for all $n, m \in H$ and all scalars α

Example 1.2 : [2] Let $W = R^3$. Define

$\|n,m\| = max\{|n_1 m_2 - n_2 m_1|, |n_1 m_3 - n_3 m_1|, |n_2 m_3 - n_3 m_2|\}$,

where $n = (n_1, n_2, n_3)$, $m = (m_1, m_2, m_3) \in R^3$.

Then $\|n,m\|$ is 2-norm on R^3

Example 1.3 : [2] Let P_n =the polynomials of h to the value $\le n$, on a range of $[0,1]$. As known, P_n is a linear space. Let $\{n_1, n_2, \ldots\ldots n_{2k}\}$ be a dependent in fixed points of $[0,1]$ and the P_n represented by 2-normd in $\|h,g\| = \sum_i^{2k} |h(n_k)\, g'(n_k) - h'(n_k)\, g(n_k)| \to (P_n, \|h,g\|)$ is a 2-normed space (see[1]).

Park [9] presented the idea of space in the quasi with 2-norm as the following

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Definition 1.4: [10] A function on $H \times H \to R$ is a quasi – 2– normed if satisfies conditions $(2N_1), (2N_2), (2N_3)$ of definition(1.1) and the conditions $(2N_4): \exists\ K \geq 1$ such that $\|n+m, w\| \leq k\,\|n, w\| + k\,\|m, w\|$ for all $n, m, w \in H$

The couple of $(H, \|.,.\|)$ is defined by quasi two– norm space (shortly q_2– normed space).

The q_2-normed $\|.,.\|$ represent the quasi- $(2;\rho)$ - normed

The collection of all 2-normed spaces are subclass of q_2-normed spaces (for $k=1$) I

$(0<p\leq 1)$ *if* $\|n+m,w\|^p \leq \|n,w\|^p + \|m,w\|^p$ *for all* $n,m,w \in H.$

n the next paragraph we recall (with details) examples of the q_2-norm spaces aren't the 2- norm spaces.

Example 1.5: [3] let $H=R^3$ and

$u=u_1 i + u_2 j + u_3 k,\ v=v_1 i + v_2 j + v_3 k \in R^3$.

Define

$$\|u,v\| = k\left|u_{i0}\, v_{i0} + 1 - u_{i0+1}\, v_{i0}\right| + \sum_{i\neq i_0}^{3} \left|u_i\, v_{i+1} - u_{i+1}\, v_i\right|$$

Where

$$\left|\mathbf{u}_{i0}\,\mathbf{v}_{i0} + \mathbf{1} - \mathbf{u}_{i0} + \mathbf{v}_{i0}\right| = \min\left\{\left|\mathbf{u}_i\,\mathbf{v}_{i+1} - \mathbf{u}_{i+1}\,\mathbf{v}_i\right| : 1 \leq \mathbf{i} \leq \mathbf{3}\right\}$$

$u_4 = u_1, v_4 = v_1$ *and* $k>1$.Then $(R^3, \|u,v\|)$ is a q_2-normed spaces .

Is not a 2-normed space.

For $u=(0,1,-1); v=(0,1,2)$ and $w=(1,0,0)$ we have

$\|u, v+w\| = \|(0,1,-1),(1,2,1)\| = k.1+3+1 = k+4$

$\|u, v\| = \|(0,1,-1),(0,2,1)\| = k.0+3+0 = 3$

$\|u, w\| = \|(0,1,-1),(1,0,0)\| = 1+k.0+1 = 2$

And $\|u, v+w\| = k+4 > \|u,v\| + \|u,w\| = 3+2 = 5.$

In this case the $(2N_4)$ will not complete the satisfaction.

Accordingly, at each $k>1$, the q_2-norm spaces $(R^3, \|u,v\|)$ will not able represent the space of two-norm.

Example 1.6: [3] suppose P_2 refer to the two degree of real multinomial, b the range of $[0,1]$. Bearing in mind the adding and vector multiplication, P_2 represent the vector space linearly. Suppose that $\{u_1, u_2, u_3, u_4\}$ is fixed points in the interval of $[0,1]$. Described by the q_2-normed on P_2 in the following

$$\|J,M\| = k\left|f(u_{i0})M`(u_{i0}) - f`(u_{i0})M(u_{i0})\right| + \sum_{i\neq i_0}^{4}\left|J(u_i)M`(u_i) - J`(u_i)M(u_i)\right|,$$

Where

$$\left|J(u_{i0})M`(u_{i0}) - J`(u_{i0})M(u_{i0})\right| = min\left\{\left|J(u_i)M`(u_i) - J`(u_i)M(u_i)\right| : 1 \leq i \leq 4\right\}$$

and $k>1$.

Then $(P_2, \|J,M\|)$ is a q_2-normed spaces.

At last, let us show that $(P_2, \|J,M\|)$ defined as above, is not a 2-normed space.

Let us consider the case $u_1=1, u_2=\frac{1}{2}, u_3=\frac{1}{3}$ and $u_4=0$= For $J=u,\ g=u^2$

And $L=(u-1)$, we have

$$\left|J(u_1)(M+L)`(u_1) - J`(u_1)(M+L)(u_1)\right| = \left|2.0-2.1\right| = 2$$

$$\left|J(u_2)(M+L)`(u_2) - J`(u_2)(M+L)(u_2)\right| = \left|\frac{5}{4}.(-1) - 1.\frac{5}{4}\right| = \frac{5}{2}$$

$$\left|J(u_3)(M+L)`(u_3) - J`(u_3)(M+L)(u_3)\right| = \left|\frac{10}{9}.\left(-\frac{4}{3}\right) - \frac{2}{3}.\frac{13}{9}\right| = \frac{66}{27} = \frac{22}{9}$$

$$\left|J(u_4)(M+L)`(u_4) - J`(u_4)(M+L)(u_4)\right| = \left|1.(-2) - 0.2\right| = 2$$

And

$$\|J, M+L\| = k.2 + \frac{5}{2} + \frac{22}{9} + 2 = k.2 + \frac{125}{18}.$$

Also, we have

$$\left|J(u_1)M`(u_1) - J`(u_1)M(u_1)\right| = \left|2.0-2.1\right| = 2$$

$$\left|J(u_2)M`(u_2) - J`(u_2)M(u_2)\right| = \left|\frac{5}{4}.(-1) - 1.\frac{1}{4}\right| = \frac{3}{2}$$

$$\left|J(u_3)M`(u_3) - J`(u_3)M(u_3)\right| = \left|\frac{10}{9}.\left(-\frac{4}{3}\right) - \frac{2}{3}.\frac{4}{9}\right| = \frac{48}{27} = \frac{16}{9}$$

$$\left|J(u_4)M`(u_4) - J`(u_4)M(u_4)\right| = \left|1.(-2) - 0.1\right| = 2$$

And $\|J,M\| = k.0 + \frac{3}{2} + \frac{16}{9} + 2 = \frac{95}{18}$

Also, we have

$$\left|J(u_1)M`(u_1) - J`(u_1)M(u_1)\right|$$
$$= \left|2.0 - 2\ .\ 1\right| = 2$$
$$\left|J(u_2)M`(u_2) - J`(u_2)M(u_2)\right| = \left|\frac{5}{4}\ .\ 0 - 1.\ 1\right| = 1$$
$$\left|J(u_3)M`(u_3) - J`(u_3)M(u_3)\right| = \left|\frac{10}{9}.0 - \frac{2}{3}.\ 1\right| = \frac{2}{3}$$
And $\left|J(u_4)M`(u_4) - J`(u_4)M(u_4)\right| = \left|1\ .\ 0 - 0.\ 1\right| = 0$

$\|J, L\| = 2 + 1 + \frac{2}{3} + k.0 = \frac{11}{3}$. From the above results, we get :

$\|J, M + L\| = k.2 + \frac{125}{18} > \|J, M\| + \|J, L\| = \frac{95}{18} + \frac{11}{3} = \frac{161}{18}$.

Therefore, for every $k > 1$, the q_2– normed space ($P_2, \|J, M\|$) is not a 2-normed space.

Definition 1.7: [11] A succession $\{t_n\}$ within the q_2–norm space (H , $\|.,.\|$) can be a Cauchy sequence if $\lim_{m,n\to\infty} \|t_n - t_m\ ,\ w\| = 0$ for each w instead of H.

Definition 1.8: [11] An order of $\{t_n\}$ into the q_2– norm space (H , $\|.,.\|$) can be similar if n point is included in H such that $\lim_{n\to\infty} \|t_n - t\ ,\ w\| = 0$ for all w in H . Consideing $\{t_n\}$ is similar to t , we write $\{t_n\} \to t$ as $n \to \infty$.

Definition 1.9: [11] Considering each Cauchy sequence is approching the element H . Then the space with linear q_2–norm (H , $\|.,.\|$) can be completed.

Definition 1.10: [11] A completed q_2 with respect to it's norm space can be defined as q_2-vector space (Banach).

Definition 1.11: Mapping $T: H \to H$ be a suppose where (H , $\|.,.\|$) is a q_2– normed space. For all $h \in H$, let $O(h) = \{h, Th, T^2h, \ldots\}$ can represent the orbit of Tat h. (H , $\|.,.\|$) is defiend by T-orbitally complete in only the case of each Cauchy sequence is enclosed by $O(h)$ collect to the H point.

Roshan elat. [12] proved some lemmas about sequences in a general metric space, here, we reform and prove in q_2–normed space .

Lemma 1.12: Permit (H, $\|.,.\|$) be a q_2– normed including the constant $k \geq 1$ and $\{h_u\}$ is the approximated sequence in H with $\lim_{u\to\infty} h_u \to h$. Then for all $u \in H$

$$s^{-1}\|h - w, T\| \leq \liminf_{u\to\infty} \|h_u - w, T\|$$
$$\leq \limsup_{u\to\infty} \|h_u - w, T\| \leq s\|h - w, T\|$$

Proof : It is clear by definitions of limit and q_2-normed function .

From lemma(1.12), it follows that if $\{h_u\} \subseteq H$ is a sequence such that

$\lim_{u\to\infty} h_u \to h$ for some $h \in H$, then $\lim_{n\to\infty} \|h_n - h, T\| = 0$.

Lemma 1.13*:* Let $\{H_n\}$ be a sequence in a q_2–normed (H, $\|.,.\|$) such that $\lim_{u\to\infty} \|h_n - h_{n+1}, T\| = 0$

If $\{h_n\}$ isn't the sequence of Cauchy, so the existence of$\varepsilon > 0$ and the 2-sequences $\{m(k)\}$ and $\{n(k)\}$ of positive numbers as following

$$\varepsilon \leq \liminf_{k\to\infty} \|h_{m(k)} - h_{n(k)}, T\|$$
$$\leq \limsup_{k\to\infty} \|h_{m(k)} - h_{n(k)}, T\| \leq s\varepsilon ,$$

$$\frac{\varepsilon}{s} \leq \liminf_{k\to\infty} \|h_{m(k)} - h_{n(k)+1}, T\|$$
$$\leq \limsup_{k\to\infty} \|h_{m(k)} - h_{n(k)+1}, T\| \leq s^2\varepsilon,$$

$$\frac{\varepsilon}{s} \leq \liminf_{k\to\infty} \|h_{m(k)+1} - h_{n(k)}, T\|$$
$$\leq \limsup_{k\to\infty} \|h_{m(k)+1} - h_{n(k)}, T\| \leq s^2\varepsilon ,$$

$$\frac{\varepsilon}{s^2} \leq \liminf_{k\to\infty} \|h_{m(k)+1} - h_{n(k)+1}, T\|$$
$$\leq \limsup_{k\to\infty} \|h_{m(k)+1} - h_{n(k)+1}, T\| \leq s^3\varepsilon \ .$$

Proof. If$\{h_n\}$ isn't classified as a Cauchy sequence, so the presence of $\varepsilon > 0$ and the sequences $\{m(k)\}$ and $\{n(k)\}$ of positive numbers as following

$n(k) > m(k) > k$, $\|h_{m(k)} - h_{n(k)-1}, T\| < \varepsilon$, $\|h_{m(k)} - h_{n(k)}, T\| \geq \varepsilon$

for all positive integers k. Now, using the triangle inequality we have

$$\varepsilon \le \left\| h_{m(k)} - h_{n(k),}, T \right\| \le s$$
$$\left[\left\| h_{m(k)} - h_{n(k)-1}, T \right\| + \left\| h_{n(k)-1}, h_{n(k)}, T \right\| \right]$$
$$< s\varepsilon + s \left\| h_{n(k)-1}, h_{n(k)}, T \right\| .$$

Taking the upper and lower limits as
$k \to \infty,\ \varepsilon \le \lim\inf_{k\to\infty} \left\| h_{m(k)}, h_{n(k)}, T \right\|$

$$\le \lim\sup_{k\to\infty} \left\| h_{m(k)}, h_{n(k)}, T \right\| \le s\varepsilon .$$

Using the triangle inequality again we have
$$\left\| h_{m(k)} - h_{n(k)}, T \right\| \le s$$
$$\left[\left\| h_{m(k)} - h_{n(k)+1}, T \right\| + \left\| h_{n(k)+1} - h_{n(k)}, T \right\| \right]$$
$$\le s^2 \left[\left\| h_{m(k)} - h_{n(k)}, T \right\| + \left\| h_{n(k)+1} - h_{n(k)}, T \right\| \right]$$
$$+ s \left\| h_{n(k)+1} - h_{n(k)}, T \right\|$$

Taking the upper and lower limits as $k \to \infty$,

we have

$$\varepsilon \le s \lim_{k\to\infty} \sup \left\| h_{m(k)} - h_{n(k)+1}, T \right\|$$

$$\le s^3 \varepsilon ,$$

Or, equivalently,

$$\frac{\varepsilon}{2} \le s \lim_{k\to\infty} \sup \left\| h_{m(k)} - h_{n(k)+1}, T \right\|$$

$$\le s^2 \varepsilon .$$

Definition 1.14 : Assume $\varphi : [0, \infty) \to [0, \infty)$ can be distance function as subadditive variation if

(i) φ is the variation of distance function (i.e., φ is continuous, strictly growing and $\varphi(t) = 0$ if and only if $t = 0$) ,

(ii) $\varphi(u+m) \le \varphi(u) + \varphi(m)$ $\forall\ u, m \in [0, \infty)$

As mentioned in [12] , $\varphi_1(u) = ku$ for some $k \ge 1, \varphi_2(u) = \sqrt[n]{u}$,

and

$n \in N, \varphi_3(u) = \log(1+u)$, $u \ge 0$
$\varphi_4(u) = \tan^{-1} u$

are some examples of sub

– additive altering distance functions .

Definition 1.15: suppose that $(H, \|.,.\|)$ is the q_2–norm space. The replacement of $T: H \to H$ can relativly be not scalable mapping on H if positive real number is presented $p < 1$ as in the following $u, v \in H,\ s^q \varphi(\|Tu - Tv, T\|)$

$$\le p\, Q(u, v) + \varphi(\|u - v, T\|)$$

For some $q \ge 5$, where $Q(u, v) = |\varphi(\|Tu - v, T\|) - \varphi(\|u - Tv, T\|)|$

$or\ \varphi(\|u - Tu, T\|) + \varphi(\|v - Tv, T\|)$

Example 1.16: From the definition, each not extensive mapping on a q_2-normed space $(H, \|.,.\|)$ is nearly not extensive mapping.

Consider q_2–normed space and $C \subseteq H$, if $C \subseteq H$, for all $u \in C$ and $h \in T$, the range of constant points of T. Relatively nonexpansive representing with $Q(u, v) =$

$|\varphi(\|Tu - v, T\|) - \varphi(\|u - Tv, T\|)|$

is a quasi – nonexpansive mapping. For,it $h \in T$ then

$\varphi(\|Tu - Th, T\|)$
$\le s^q \varphi(\|Tu - Th, T\|)$
$\le p|\varphi(\|Tu - h, T\|) - \varphi(\|u - Th, T\|)|$
$+ \varphi(\|u - h, T\|)$
$= p\{\varphi(\|Tu - Th, T\|) - \varphi(\|u - Th, T\|)\}$
$+ \varphi(\|u - h, T\|)$, $if\ \|Tu - h, T\| > \|u - Th, T\|$ $p\{\varphi(\|u - Th, T\|) - \varphi(\|Tu - h, T\|)\}$
$+ \varphi(\|u - h, T\|)$, $if\ \|Tu - h, T\| > \|u - Th, T\|$,

Acoordingly, in each of those conditions, the we got
$\varphi(\|Tu - Th, T\|) \le \varphi(\|u - h, T\|)$,

that is, $\|Tu - h, T\| \le \|u - h, T\|$. However, with $Q(u, m) = \varphi(\|u - Tu, T\| + \varphi(\|m - Tm, T\|))$, May be the relatively non-expansive mapping is not a q-non-expansive mapping.

Theorem 1.17 : Let $(H, \|.,.\|)$ *be* T- orbitally complete q_2– normed with $k = 1$ *or* $k \ge 2$ *and* $T: H \to H$ be an almost nonexpansive mapping with

$$\|T_n - T_m, w\|$$
$$\le K \|n, w\| + K \|m, w\|$$

For some $q \ge 5$ *and* $0 \le p < 1$ *with* $kp < 1$. *If* T *is* asymptotically regular *at* $h_0 \in H$, then T has a fixed point .

Proof *:* Since T is is asymptotically regular *at* $h_0 \in H$ we have $\lim_{n\to\infty} \|T^n h_0, T^{n+1} h_0, T\| = 0$

Firstly, we prove that $\{h_n\} \subseteq H$ defined by $h_n = T^n h_0$ represent Cauchy chain where, each $\varepsilon > 0$ one able to find $k \in W$ within $\forall\, h \geq k$, $\left\| h_t, h_g, T \right\| < \varepsilon$.

Otherwise, Lemma (1.13) existence of $\varepsilon > 0$ where the the subsequence was able to be founded $\{H_{h(i)}\}$ and $\{H_{t(i)}\}$ of $\{H_n\}$ with $h(i) > f(i) \geq i$ and

$(a)\ f(i) = 2t'$ *and* $h(i) = 2t + 1$, where t and t are nonnegative integer,

$(b)\quad \rho\left(H_{f(i)}, H_{h(i)}\right) \geq \varepsilon$, *and*

It's the lowest number in this case (b) $(c)\quad h(i)$.

believes is that, $\rho\left(H_{t(i)}, H_{g(i)-1}\right) < \varepsilon$

Hence by continuousness, sub– uniformity, and rising the characteristics of φ we got

$$\varphi(\varepsilon) \leq \left(\lim_{i\to\infty} \sup k \left\| h_{t(i)} - h_{g(i)}, T \right\|\right),$$

$$\leq S\varphi(\varepsilon),$$

$$\varphi(\varepsilon) \leq S\varphi(\varepsilon),$$

$$\frac{\varphi(\varepsilon)}{s} \leq \varphi\left(\lim_{i\to\infty} \sup k \left\| h_{t(i)} - h_{g(i)}, T \right\|\right)$$

$$\leq S^2\varphi(\varepsilon),$$

$$\frac{\varphi(\varepsilon)}{s} \leq \varphi\left(\lim_{i\to\infty} \sup k \left\| h_{t(i)+1} - h_{g(i)}, T \right\|\right)$$

$$\leq S^2\varphi(\varepsilon),$$

$$\frac{\varphi(\varepsilon)}{s^2} \leq \varphi\left(\lim_{i\to\infty} \sup k \left\| h_{t(i)+1} - h_{g(i)+1}, T \right\|\right)$$

$$\leq S^3\varphi(\varepsilon).$$

From (1.15), we have,

$$S^q \varphi\left(k\left\| h_{t(i)+1} - h_{g(i)+1}, T \right\|\right)$$

$$\leq k\left|\varphi\left(\left\| h_{t(i)} - h_{g(i)}, T \right\|\right) - \varphi\left(\left\| h_{t(i)} - h_{g(i)+1}, T \right\|\right)\right|$$

$$+ \varphi\left(\left\| h_{t(i)} - h_{h(i)}, T \right\|\right).$$

Taking the upper limit as $i \to \infty$, we get

$$S^q \varphi\left(\lim_{i\to\infty} \sup \left\| h_{f(i)+1} - h_{h(i)+1}, T \right\|\right)$$

$$\leq \rho\left|S^2\varphi(\varepsilon) - \frac{\varphi(\varepsilon)}{s}\right| +$$

$$s\varphi(\varepsilon) < 2S^2\varphi(\varepsilon),$$

O r,

$$\varphi\left(\lim_{i\to\infty} \sup \left\| h_{m(i)+1} - h_{h(i)+1}, T \right\|\right)$$

$$< \frac{2\varphi(\varepsilon)}{s^{q-2}} < \frac{2\varphi(\varepsilon)}{s^3}$$

Since $q \geq 5$, contradicting for $k \geq 2$. We note here that if $k = 1$, then T is approximately unvarying at $h_0 \in H$ indicates $\{h_n\}$ represent Cauchy sequence, that simply observed. So $\{g^n h_0\}$ is also Cauchy sequence and subsequently $(H, \|.,.\|)$ is completely orbital, and it exists $h \in H$ for example $\lim_{h\to\infty} g^n h_0 = Z$.

Now, applying (1.15)

$$\varphi(\|z - gz, T\|) \leq s\varphi\left(\left\| h - g^{n+1} h_0, T \right\|\right)$$

$$+ s^q \varphi\left(\left\| g^{n+1} h_0 - gh, h \right\|\right)$$

$$\leq s\varphi\left(\left\| h - g^{n+1} h_0, T \right\|\right) +$$

$$\left|\varphi\left(\left\| h - g^{n+1} h_0, T \right\|\right) - \varphi\left(\left\| g^n h_0 - gh, T \right\|\right)\right|$$

$$+ \varphi\left(\left\| g^n h_0 - h, T \right\|\right)$$

Considering this limits $n \to \infty$, by lemma (1.13)

The outcomes, $(1 - s\rho)\ \varphi\left(\left\| h - gh, T \right\|\right) \leq 0$,

Hence, $\varphi\left(\left\| h - gh, T \right\|\right) = 0$ or $\left\| h - gh, T \right\|$

i.e., $gh = h$,

as required.

Remark 1.18: In theorem (1.17), T got an exclusive constant point in case of $(H, \|.,.\|)$ isn't a quasi-2-normed (i.e,$k \neq 1$). Where, if $w \in Y$ is also a fixed point of T,

Therefore, from (1.15)

$$s^q \left\| h - w, T \right\| \leq p\left|\left\| h - w, T \right\| - \left\| h - w, T \right\|\right| + \left\| h - w, T \right\|,$$

Which implies $(h - w, T) = 0$ (since $k \geq 2$), as claimed.

Corollary 1.19: A nonexpansive mapping on a q_2–normed $(H, \|.,.\|)$ got a fixed point in case of asymptotically unvarying at any point of H.

Proof. The proof is followed based on Theorem (1.17) by considering φ employing the identified mapping $p=0 \; and \; k=1$.

Theorem 1.20: Let $(H, \|.,.\|)$ be a complete q_2–normed and $T:H\to H$ be a mapping such that for all $u, m \in H$, $s^q \varphi(\|Tu-Tm,T\|)$
$\leq p\{\varphi(\|u-Tu,T\|)+\varphi(\|m-Tm,T\|)\}$
$+ \varphi(\|u-m,T\|)$,
In few non-negative real number $p<1$ with $kp<1$ and $q\geq 5$.
In case of T is representing asymptotically stable at a point $u_0 \; of \; H$, then T have a fixed point.
Proof. as T is approximately stable at $u_0 \in H, \lim_{n\to\infty}\|T^n u_0 - T^{n+1}u_0, T\|=0$.

Thus the sequence $\{u_n\}$ defined by $u_n = T^n u_0$, $n \in W$ is a Cauchy sequence as proven in Theorem (1.17). As $(H, \|.,.\|)$ is integral, so it exists $h \in H$
For example
$\lim_{n\to\infty} u_n = h$.
Herein, meanwhile φ is sub-additive and sub-identical varying distance function and
$q \geq 5, \quad \varphi(\|h-Th,T\|)$
$\leq s\varphi\left(\|h-T^{n+1}u_0,T\|\right) +$
$s\varphi\left(\|T^{n+1}u_0-Th,T\|\right)$
$\leq s\varphi\left(\|h-T^{n+1}u_0,T\|\right) +$
$s^q\varphi\left(\|T^{n+1}u_0-Th,T\|\right)$.
In the above expression, we get,
$\varphi(\|h-Th,T\|)$
$\leq s\varphi\left(\|h-T^{n+1}u_0,T\|\right)$
$+ p\left\{\varphi\left(\|T^n u_0-T^{n+1}u_0,T\|\right)+\varphi(\|h-Th,T\|)\right\}$
$+ \varphi\left(\|T^n u_0-h,T\|\right)$.

Considering the range of $n \to \infty$ and utilizing Lemma (1.13), the result, $(1-sp)\ \varphi(\|h-Th,T\|) \leq 0$,
That demonstrates $Th = h$, as required.

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Arabic Abstract

لغرض تحقيق هدف هذه المقالة تم اعادة تعريف كل من الفضاءات 2 - المعيارية و شبه 2- معيارية. هناء نقدم فئة جديدة من التطبيقات تسمى التطبيقات اللا متمددة غالبا في الفضاءات شبه 2- معيارية. لقد تم مناقشة بعض خصائص هذه الفئة من التطبيقات. حيث تم إثبات نتائج حول النقطة الصامدة لها.

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Toxic Effect of Peganum Harmala L. on Some Physiological Parameters in the Livers of Rabbits

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P A P E R I N F O

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A B S T R A C T

In this study, (20) adult male laboratory white rabbits (Lepus arcticus) were used, with an age ranging from eight months to one year. Their weights ranged between 1,500 to 1,600 kg .. It was divided into the first and second group . where the first group included the group injected subcutaneously with the "alcoholic extract" of Harmala plant seeds with a concentration 3 mg / kg , which included (10) rabbits. The second group was the control, which contained (10) rabbits. In this research, the levels of the AST and ALT enzymes were estimated, and the percentage of some blood proteins such as total protein, albumin, and globulin were measured. Through this study, it was found that:

1- There was a significant increase (P<0.05) in the levels of AST - ALT enzymes compared with the "control group. "

2- There was also a significant decrease (P<0.05) in the average total protein level and the average albumin level compared with the "control group. "

3- No significant differences (P>0.05) were observed in the average globulin level compared with the "control group" .

1. INTRODUCTION

Harmala is a prevalent medicinal herb in the realm of traditional medicine. The plant is herbaceous and is commonly utilized as a medicinal herb in several nations including Africa, Europe, Central Asia, East Asia, and North Asia. It is particularly prevalent in the Arabian Gulf region, such as the Kingdom of Saudi Arabia and some countries like Iran, Pakistan and India [1]. P. harmala belongs to the family of Zygophyllaceae [2]. This family includes approximately 25 genera and more than 250 species [3]. It is considered as one of the perennial plant groups in semi-arid regions around the world. [4] It is used as a treatment for rheumatism, epilepsy, jaundice, sciatica, headaches, forgetfulness and all types of pain.

The Greeks also used powdered caramel seeds to treat fever and worms, and in Yemen it was used as a drink to treat chronic malaria after mixing it with tamarind, and in Turkey it was used in the form of dry capsules to treat envy and to expel evil eye and witchcraft.[5] Harmala is also burned after mixing it with some substances for inhalation for the purpose of sneezing or to purify the air and numb the nerves [6]. About 56 medical cases were recorded in Tunisia on patients to determine the toxic effects of harmala from 1983 to 1998. Concerning the ratio of men to women aged 26 years, it was 1/2, in addition to the occurrence of neurological effects of harmala at a rate of 91%, and intestinal and gastrointestinal effects 73%.For the percentage of its effect on the heart and vessels, it was 18% [7]. Previous research has shown that environmental factors may affect the chemical composition of this plant [8] because it contains alkaloids of the type beta-carboline (B-Carboline), which are the active medicinal substances in the plant [9]. The percentage of these compounds ranges between (2-7) % in dry seeds [10]. The biological and medicinal effectiveness of the Harmala plant is due to its alkaloids, especially Harmala Indolic Alkaloids, especially Harmaline, Harmine, Harmlol, and peganine [11]. Indole compounds contain more than (1400) different compounds that have efficient functions and are used in medical fields. Harmala was mentioned in ancient Arab medicine recipes to treat joint pain, colon, and diseases of asthma, chest pain, epilepsy, headaches,

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and other diseases [12]. The powder extracted from the seeds of the caramel plant is exploited in Greece as an anti-tapeworm and fever-reducing agent [13]. However, excessive consumption of this herb can also cause toxic complications for the consumer [14]. The species P Harmala (multi sectum) which belongs to the genus Haramel, has the ability to hinder the germination and growth of soil-borne fungus and disease-causing pesticides. It is also effective against two types of aphids (Schizaphis graminum and M. persicae).[15]

Haram is an abortifacient and it is antibacterial, which is used to treat psychological diseases. It also has therapeutic anti-inflammatory effects [16] and is a pain reliever for eczema and skin diseases such as visceral leishmaniasis [17]. Experiments and scientific research have proven that the alkaloid of the Harmala plant possesses biological activity that kills microorganisms, antibacterial activity that acts on the cell wall, kills fungi and bacteria, and is an antitussive [18,19]. The harmala plant thrives in steppe regions, semi-arid environments and sandy soils [20,21] showed that harmala has great anti-allergy and therapeutic anti-tumor effectiveness. The seeds also have a superior ability to activate phagocytic cells [22]. Harmala has been used for a long time against diabetes [23]. It is used to lower blood pressure and as an emetic agent, in addition to using the smoke of caramel seeds as incense to eliminate epidemics and as a sedative agent [24]. A study [25] showed the effect of poisonous harmala on rabbits, small camels, monkeys, sheep, and horses when the animal consumes lethal doses and its effect on the digestive system and the nervous system. Poisoning rabbits with poisonous harmala causes congestion in the heart, lungs, kidneys, stomach, intestines, and bleeding in the liver, as shown. [26]. Today, harmala is considered one of the most promising plants and the most attractive to the attention of scientists in the field of pharmaceutical manufacturing, especially after more in-depth studies have been carried out to determine the pharmacological and toxicological effects of many of the extracts and components of this plant. The need has arisen to conduct a number of studies and research on this subject, and therefore the current study aims to know the functional effects of the alcoholic extract of the seeds of the harmala plant on some enzymes and proteins of the blood serum **.**

2. MATERIALS AND METHODS

The experiment in this study was designed to determine the effect of harem seeds on some functional blood parameters in white male rabbits. The experiment began from February 2024 to May 2025, and the study was conducted in several places (College of Education for Pure Sciences/ Department of Biology / University of Kerbala- and private laboratories to conduct tests). The study was carried out on (20) rabbits, divided into two groups. The first group N= (10) male rabbit were given 3 mg/kg of alcoholic extract of the seeds of the Haramel plant (patient group) , and the second group N= (10) male rabbit were given distilled water (control group). The animals were injected with the concentration mentioned below. Skin using sterile medical syringes with a capacity of 5 milliliters every day for 30 days were used. The animals were anaesthetized using chloroform. The procedure involved accessing the abdominal cavity and extracting blood directly from the heart by puncturing it, in order to acquire a substantial quantity of blood. The blood samples were deposited in sterile test tubes without anticoagulant, each with a volume of 10 ml, and were allowed to sit for a duration of 20-25 minutes. At laboratory temperature, then the tubes were transferred to the centrifuge at a speed of (3000) rpm for 15 minutes in order to obtain the serum, which was kept in the refrigerator at a low temperature (-4) degrees Celsius, [27] until some analyzes and functional standards are conducted, such as (ALT-AST Globulin-Albumin-total protein).

2.1 .Functional Laboratory Tests for Blood

1-The estimation of the enzyme level of Glutamic Oxaloacetic Transaminase (AST) & Glutamic Pyruvate Transaminase (ALT). The enzyme level (AST-ALT) in the serum was estimated by colorimetric method according to method [28].

2 -The level of total protein in blood serum was estimated calorimetrically according to the Biuret method [29].

3 -The estimation of the level of albumin. The level of albumin in the blood serum was estimated by the colorimetric method and based on the ability of the albumin to bind with the dye (BCG) Bromocresol Green, as the color changes from yellow-green to blue-green according to method [30].

4 -The estimation of the level of globulin in the blood serum. The level of globulin was measured indirectly, after measuring the level of albumin. After that, the result was subtracted from the result of the total protein measurement according to the following equation: Globulin Conc. (g/dl) = Total protein Conc.– Albumin Conc [31].

2.2 .Statistical Analysis

The primary data of the research results were analyzed statistically using the T-test at the level of significance ($P < 0.05$) [32].

3. RESULTS AND DISCUSSIONS

The results of the functional study shown in Table 1 revealed a concentration of 3 mg/kg for the group of alcoholic extract of the seeds of the caramel plant in the serum of the rabbit. There was a significant increase ($P < 0.05$) in the enzymatic rate (AST-ALT) , which reached , respectively , (26.21±1.23) U/L

(±24.31±1.90) compared with the control group (15.49±1.59) , (13.18±3.21) U/L individually. This result matches the result of [33] reached in his study through the effect of injection into the peritoneal cavity and administration of orally administered for six consecutive weeks of caramel seed extract at a dose of 200 gr / kg in albino mice. It caused a significant increase in the level of liver enzymes (AST-ALT) as well as severe tissue damage to the liver represented by swelling of hepatic cells as a result of the accumulation of fats inside them. This indicates that it leads to fatty degeneration of the cells and damage and necrosis in the liver lobules. These results can be explained as an outcome of treatment with harmala due to the toxicity of harmala seeds. This is especially the case with the toxic alkaloids, harmine and harmaline, which led to an imbalance in the physiological function of the liver. The reason may be due to an increase in the AST-ALT enzyme as a result of the kidney injury. Due to decreased cardiac output resulting from kidney injury, as blood flow to the kidney is reduced, leading to its inability [34].

This does not match the result reached by [35] in this study when giving the methyl alcoholic extract at concentrations of 200 and 300 mg/L to chicken broilers for 38 days with drinking water. While study [36] indicated a decrease in these two enzymes when giving the extract of harmala to male rats as a result of sulfur poisoning. This study indicated the effect of harmala in protection. The results of the functional study shown in (Table 2) also showed a concentration of 3 mg/kg for the alcoholic extract group of harmala seeds. In the rabbit's blood serum, there was a significant decrease in the average total protein level and the average albumin level compared to the control group. It reached (2.41±0.71) and (4.31±0.38 g/dl) compared to the control group, which is (4.91±0.63), (6.21±0.09) g/dl micrometer, respectively. The results of this study agree with the study [37] which was conducted on chickens when giving ram seeds extract for six weeks.

It was noticed that an increase in the weight of the liver took place, as well as a decrease in the level of proteins and albumin in the blood serum. The reason for the decrease may be due to a case of nephritis or inflammation of the glomerulus and nephrons, as the amount of protein in the urine increases or as a result of a condition. Lack of albumin concentration in the blood serum [38]. Protein deficiency often results in liver disease due to lack of protein intake in food or lack of absorption. Also, the level of albumin decreases in the blood serum due to liver damage and severe diseases [39]. [40] have stated that the presence of small amounts of urinary albumin is an indicator of the risk of developing diabetic nephropathy or large vessel disease. This condition is called micro albuminuria. The results of the current study also indicated that there are no clear significant differences (P > 0.05) in the rate of Globulin level compared with the control group reached (3.41±0.63) and (3.23±0.56) g/dl, separately.

TABLE 1. The effect of the alcoholic extract of the seeds of the harmala plant on the average level of the AST-ALT enzyme in white male rabbits after they were injected subcutaneously with the alcoholic extract of the seeds of the harmala plant at a concentration of 3 mg/kg for (30) days.

Average enzyme level of ALT U/L	enzyme level rate of AST U/L	Studied standards mean±S.D
Harmala	Harmala	Abstract Concentration
26.21±1-23 B	24.31±1.90 B	mg/kg3
13.18±3.21 A	15.49±1.59 A	Control distilled water

Values represent mean ± standard error, different capital letters indicate significance P<0.05

TABLE 2. The effect of the alcoholic extract of the seeds of the harmala plant on the average level of some proteins in the blood serum of white male rabbits after they were injected subcutaneously with the alcoholic extract of the seeds of the harmala plant at a concentration of 3 mg/kg for (30) days.

Average globulin level g/dl	Average albumin level g/dl	Average total protein level g/dl	Studied standards mean±S.D
Harmala	Harmala	Harmala	Abstract Concentration
3.23±0.56 A	2.41±0.71 B	4.31±0.38 B	mg/kg3
4.41±0.63 A	4.91±0.63 A	6.21±0.09 A	Control distilled water

Values represent mean ± standard error, different capital letters indicate significance P<0.05

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Arabic Abstract

استخدمت في هذة الدراسة (20) ارنبا من ذكور الارانب البيض المختبرية البالغة بعمر يتراوح ما بين ثمان اشهر الى سنة , وتراوحت أوزانهم بين 1500 إلى 1600 كجم . قد قسمت إلى مجموعتين الأولى والثانية حيث ضمت المجموعة الأولى المجموعة المحقونة تحت الجلد بـ "المستخلص الكحولي" لبذور الحرمل بتركيز (3ملغم /كغم) والتي ضمت على (10) ارانب أما المجموعة الثانية فكانت مجموعة السيطرة والتي ضمت (10) أرانب في البحث تم تقدير مستوى انزيمي AST,ALT وقياس نسبة بعض البروتينات الدموية كالبروتين الكلي والألبومين والكلوبيولين . وجد من خلال هذة الدراسة :-

1- هناك زيادة معنوية ($P<0.05$) في مستويات انزيمي ALT - AST مقارنة بمجموعة السيطرة .

2- كما حدث انخفاض معنوي ($P<0.05$) في متوسط مستوى البروتين الكلي ومتوسط مستوى الالبيومين مقارنة بمجموعة السيطرة .

3- لم يلاحظ أي فروق معنوية ($P>0.05$) في متوسط مستوى الجلوبيولين مقارنة بمجموعة السيطرة .

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Even Sum Edge Domination in Graph

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A B S T R A C T

Various applications of domination and recent work on different forms of domination in graphs have given rise to our interest in exploring in this paper new special type of graph domination. As most papers discussed domination focus more on setting the conditions for the dominant group to come up with a new concept of domination, this pape introduces the new parameter of domination in graph called even sum edge domination set (ESEDS). Many of properties of these numbers are being discussed. Furthermore, for the path and related to it as thorn, thorn path, and thorn rod path are presented. Also, the algorithm of even sum edge domination of path is introduced.

1. INTRODUCTION

The domination graph is very important number in variant fields in sciences and many applications in real life as in physics, chemistry, biology, engineering, medicine and others. This concept is first appeared in 1962 by Berge [1] and then this concept is used to find solution to many problems in various sciences. The new concept of even sum domination set on vertices was defined by Rasheed and Omran [2]. They have studied many properties of this concept on certain graphs [3]. The concept of domination graph deals with different fields in mathematics such as labeled graph [4], topological graph [5-8], fuzzy graph [10,11], and general graph [9] and [12,13]. This work deals with the undirected finite simple graph. The edge even sum domination introduces and discusses many properties of this new concept. Many theorems, properties, corollary are proved. For path and related path as thorn path and thorn rod path the even edge domination is determined. Additionally. The algorithm of even sum

edge domination is calculated. More details about the concepts in graph theory can be found in [6,7].

2. BASIC DEFINITIONS

Definition .1: The edge degree $d(e)$ of the edge $e = uv$ is defined as the number of neighbors (a common vertex with the edge e) of e, i.e., $|N(u) + N(v) - 2|$. Definition .2: Let (V, E) be a graph that has no isolated vertex and F is a set of edges, the set F is called an edge dominating set (EDS) if, for each $e_i \in E - F$ there is an edge $e_j \in F$ adjacent to e_i (every edge not in F adjacent to at least one edge in F).Definition .3: Let (V,E) be a graph that has no isolated vertex and F is an EDS, the set F is called even sum edge domination set (ESEDS) if for every $e_i \in E - F$ there is an edge $e_j \in F$adjacent to e_i such that $deg(e_i) + deg(e_j)$ is even.

Definition .4: Let D be an ESEDS in a graph, if the set D has no proper ESEDS, then this set is called minimal ESEDS (MESDS). Furthermore, the even sum domination number is the minimum cardinality of all MESEDS, and denoted by $\gamma'_{es}(G)$.

If D is an MESEDS that has the minimum cardinality, then D is called γ'_{es}-set.

Observation: Assume that G is a graph with n vertices and D is a γ'_{es} −set, then

1) Each K_2 component in graph G belongs to every ESEDS.

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2) Every edge e_i in the set $V - D$ has an even (odd) degree is adjacent to at least one edge e_j in D that has an even (odd) degree.
3) An edge has an odd (even) degree that belongs to every ESEDS, if it is not adjacent to edge has odd (even) degree.
4) $\gamma'_{es}(G) \leq \gamma'(G)$.

3. THE MAIN RESULTS

Proposition .1: Let G be a regular graph, then $\gamma'_{es}(G) = \gamma'(G)$.

Proof. Let G be a regular graph, so the degree of all vertices is equal say r. Thus, the degree of all edges is $(2r-2)$.So, there are two cases: one of them $(2r-2=0)$, therefore $G \equiv K_2$ otherwise $(2r-2)$ is even.

Thus, $\gamma'_{es}(G) = \gamma'(G)$.

Remark .2: The converse of the previous proposition is not necessarily true. For example, take the star graph (S_6) where $S_6 \equiv K_{1,5}$.

Corollary 3.
1) $\gamma'_{es}(K_n) = \gamma'(K_n) = \left\lceil \frac{n}{2} \right\rceil$.
2) $\gamma'_{es}(C_n) = \gamma'(C_n) = \left\lceil \frac{n}{3} \right\rceil$.

Proposition. 2: Let G be a path of order $n; n \geq 2$, so

$$\gamma'_{es}(P_n) = \begin{Bmatrix} 1, & if\ n = 2,3 \\ 2 + \left\lceil \frac{n-3}{3} \right\rceil, & if\ n \geq 4 \end{Bmatrix}.$$

Proof. The proof is treated separately for two cases.

Case 1. If $n = 2$, then $P_2 \equiv K_2$, thus $\gamma_{es}(P_2) = 1$. Also, if $n = 3$, then there are only two disjoint edges each of them of degree 3, so $\gamma_{es}(P_3) = 1$.

Case 2. If $n \geq 4$, then the degree of each pendant edge is 1 and not adjacent to an edge of odd degree. Thus, by Observation 5, these edges belong to every ESEDS. These two edges do not dominate to adjacent edges since these have an odd degree and the adjacent have an even degree. All remained edges have even degree, so all three consecutive edges can be dominated by one edge. The three consecutive edges are covering four vertices thus, $\gamma_{es}(P_n) = 2 + \left\lceil \frac{n-3}{3} \right\rceil$.

From the cases above, the result is obtained.

Algorithm .1: ESEDS-PATH (G is a path of order n)

Input: the vertex set $V = \{v_1, v_2, \ldots, v_n\}$, $v_1$and v_n are the pendant vertices

1. $ESEDS := \emptyset$;
2. Case 1: $n = 2\ or\ 3$;
3. $ESEDS := \{e_1\}$;
4. Case 2: $n \geq 4$;
5. $ESEDS := \{e_1, e_n\}$;
6. For $i := 3\ \ to\ \ n-1$ step 2, do;
7. $ESEDS := ESEDS \cup \{e_i\}$;
8. end for; Output: $ESDS$ Proposition .3: Let G be a thorn path $P_{n,r,s}$. Then

$$\gamma'_{es}(P_{n,r,s}) = \begin{Bmatrix} n + \left\lceil \frac{n}{3} \right\rceil, & if\ s\ is\ odd\ and\ r\ is\ even \\ 2 + \left\lceil \frac{n-4}{2} \right\rceil, & if\ s\ and\ r\ are\ odd\ or\ s\ is\ even\ and\ r\ is\ odd \\ n + \left\lceil \frac{n-2}{3} \right\rceil, & if\ s\ and\ r\ are\ even \end{Bmatrix}$$

.

Proof. The proof is treated separately for three cases.

Case 1. If $s\ is\ odd\ and\ r\ is\ even$, then all terminal edges in the thorn graph have an odd degree and all edges of the path graph (non-terminal edges in the thorn graph) have an even degree (as an example, see Figure 1). Thus, the terminal edges do not dominate the non-terminal edges, so take one edge from each terminal that is adjacent to a vertex (say v)in the path of order n. This edge dominates all edges which are adjacent to the vertex v and do not belong to the path graph. Therefore, the number of these edges is n. The remained edges, that are not adjacent by these edges, are the edges of the path graph. Now, all edges in the thorn graph that belong to the path graph have an even degree. Accordingly, all three consecutive edges can be dominated by one edge. Thus, the minimum number of edges that dominates the edges of the path graph is $\left\lceil \frac{n}{3} \right\rceil$. Therefore, $\gamma'_{es}(P_{n,r,s}) = n + \left\lceil \frac{n}{3} \right\rceil$.

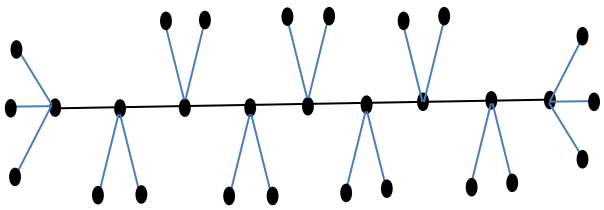

Figure 1. The thorn graph $P_{9,2,3}$

Case 2. If $s\ and\ r$ are odd, then all terminal edges in the thorn graph that are adjacent to the pendants vertices of the path graph have odd degree in addition to the pendants vertices of path. Thus, the pendant vertices

must belong to the minimum ESEDS. These two vertices dominate the terminal edges in the thorn graph that adjacent to it (as an example, see Figure 2).

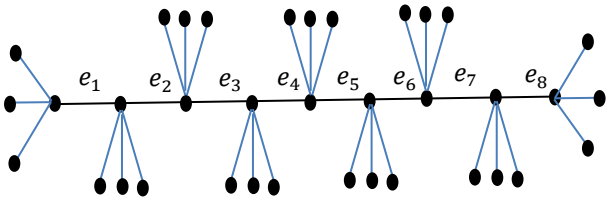

Figure 2. The thorn graph $P_{9,3,3}$

All remained edges of the thorn graph have even degree, so the set $D_1 = \left\{e_{3+2k}, k = 0,1, \dots, \left\lceil\frac{n-4}{2}\right\rceil\right\}$ where all these edges belong to the path graph (as an example, see Figure 2). The set D_1 is the minimum ESEDS of the remain vertex that not dominate by the edges e_1 and e_n and the number vertices of the set D_1 is $\left\lceil\frac{n-2}{2}\right\rceil$. Thus, $\gamma'_{es}(P_{n,r,s}) = 2 + \left\lceil\frac{n-4}{2}\right\rceil$.

Case 3. If $s\ is\ even\ and\ r\ is\ odd$, then all edges in the thorn graph have even degree (as an example, see Figure 1).

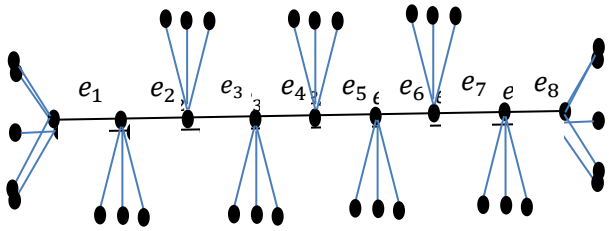

Figure 3. The thorn graph $P_{9,3,2}$

The pendant edges of the path graph (as an example, $e_1\ and\ e_8$ in the Figure 3) must belong to the minimum ESEDS to dominate the terminal edges that adjacent to it. In same technique in previous case the set D_1 is minimum ESEDS to other edges in the thorn graph. Thus, $\gamma'_{es}(P_{n,r,s}) = 2 + \left\lceil\frac{n-4}{2}\right\rceil$.

Case 4. If $s\ and\ r$ are even, the terminal edges in the thorn graph that adjacent to the pendant vertices in the path graph have even degree and the pendant vertices of the path have odd degree, thus one edge from the terminal edges must be taken in the minimum ESEDS (as an example, see the Figure 4).

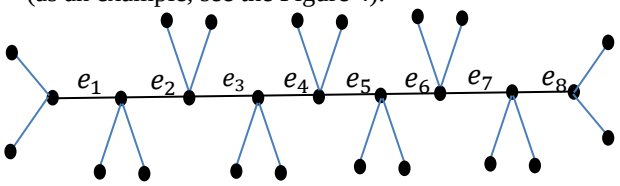

Figure 4. The thorn graph $P_{9,2,2}$

This edge dominates all other terminal edges that adjacent to it. The same technique used in the other terminal, sine for each vertex in the path graph, all terminal edges that adjacent to it have odd degree. Also, the edges of path graph except the pendant have even graph. Thus, again one edge from the terminal edges of a vertex in the path graph must be taken in the minimum ESEDS. The remained vertices which no dominate by the select previous edges are the vertices of path graph except the terminal edges. Therefore, the minimum number of edges that dominate the remained edges is $\left\lceil\frac{n-2}{3}\right\rceil$. Thus, $\gamma'_{es}(P_{n,r,s}) = n + \left\lceil\frac{n-2}{3}\right\rceil$.

From the cases above, the result is obtained.

Proposition .4: Let G be a thorn rod path $P_{n,m}$. Then

$$\gamma'_{es}(P_{n,m}) = \begin{cases} 1, & if\ n = 2\ and\ m\ is\ even \\ 3, & if\ n = 2\ and\ m\ is\ odd \\ 4 + \left\lceil\frac{n-3}{3}\right\rceil, & if\ n > 2\ and\ m\ is\ even \\ 2 + \left\lceil\frac{n-1}{3}\right\rceil, & if\ n > 2\ and\ m\ is\ even \end{cases}.$$

Proof. The proof is treated separately for four cases.

Case 1. If $n = 2$ and m is even, then all edges of the thorn rod graph are even degree, so the edge of path dominates all other edges. Thus, $\gamma'_{es}(P_{2,m}) = 1$.

Case 2. If $n = 2$ and m is odd, then all terminal edges of the thorn rod graph have odd degree and the edge of path has even degree. Thus, one of terminal edges must be taken in the minimum ESEDS from each side of the path. Also, the edge of P_2 must be taken according to observation 5. Thus, $\gamma'_{es}(P_{2,m}) = 3$.

Case 3. If $n > 2$ and m is even, then all terminal edge of the thorn rod path graph has even degree. In addition, the pendant edges of the path graph have odd degree. Finally, the other edges of path graph have even degree (as an example, see the Figure 5).

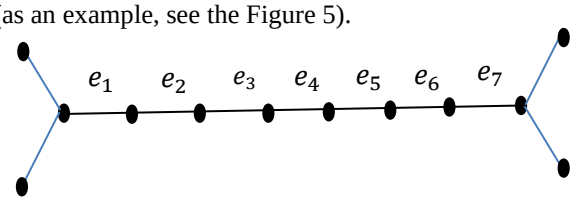

Figure 5. The thorn rod graph $P_{n,2}$

In each side of the path, one each must be taken to add to the minimum ESEDS to dominate all terminal edges in the thorn rod path graph. Also, the terminal edges of the path graph (as an example, e_1 and e_8 in the Figure 5) must be taken in the minimum ESEDS, according to Observation 5. The remained edges which are not

dominated by the four vertices are $\{e_2, e_3, \dots, e_{n-1}\}$ of the path graph. All these edges have even degree, so all edges in thorn graph that belong to the path graph have even degree. Therefore, all three consecutive edges can be dominated by one edge and $\gamma'_{es}(P_{2,m}) = 4 + \left\lceil \frac{n-3}{3} \right\rceil$.

Case 4. If $n > 2$ and m is odd, then all terminal edge of the thorn rod path graph has odd degree. In addition, all the edges of the path graph have even degree (as an example, see Figure 6).

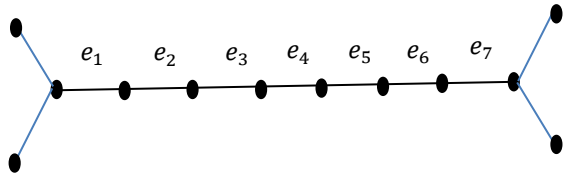

Figure 6. The thorn rod graph $P_{n,3}$

In each side of the path, each one must be taken to add to the minimum ESEDS to dominate all terminal edges in the thorn rod path graph. The remained edges not dominated by the two vertices are $\{e_1, e_2, \dots, e_n\}$ of the path graph. All these edges have even degree, so all edges in thorn graph that belong to the path graph have even degree. Therefore, all three consecutive edges can be dominated by one edge and $\gamma'_{es}(P_{2,m}) = 2 + \left\lceil \frac{n-1}{3} \right\rceil$.

From the cases above, the result is obtained.

3. APPLICATIONS

In this paper, many applications are stated to domination. As in the case of the main subject applications, this subject has specialized applications such as its use in inspection of two types or any application that requires two classes of work. To obtain an even number from adding two numbers, they are either both even or both odd. Domination in graphs has applications to several fields like school bus routing, computer communication networks, locating radar stations problem, nuclear power plants problem, modeling biological networks, modeling social networks, facility location problems, and coding theory. For more details about the applications in domination the reader can see [14].

4. CONCLUSIONS

Throughout this paper a new definition of domination in graphs is introduced which is called even sum domination. The results obtained in this study depended on the edge set.

For the edge set many properties and bounded are determined. For some certain graphs such as path, thorn, and thorn rod, this number is calculated with giving an algorithm for path. In future we extend this work with algorithms to calculate this number for more certain graphs.

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Arabic Abstract

أدت التطبيقات المختلفة للهيمنة والبحوث الحديثة حول أنواع مختلفة من الهيمنة في المخططات إلى إثارة اهتمامنا باستكشاف نوع خاص جديد من الهيمنة في المخططات وذلك ما قمنا به في هذا البحث. إن معظم البحوث التي تمت دراسنها في الهيمنة تركز بشكل أكبر على تحديد الشروط على المجموعة المهيمنة للتوصل إلى مفهوم جديد للهيمنة. في هذا البحث، قمنا بتقديم المعلمة الجديدة للهيمنة في المخطط والتي تسمى مجموعة سيطرة الحافة ذات المجموع الزوجي .(ESEDS) وقمنا بمناقشة العديد من خصائص هذه الأعداد. علاوة على ذلك، قدمنا المفهوم الجديد لمخطط المسار وما يرتبط به مثل مخطط الشوكة ومخطط مسار الشوكة ومسار قضيب الشوك. كما وضعنا خوارزمية للحصول على مجموعة هيمنة الحافة ذات المجموع الزوجي لمخطط المسار.

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Hormonal Profile Changes as A predictive Marker for Polycystic Ovary Syndrome and Infertility in Women

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P A P E R I N F O

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Infertility, Testosterone, Sex hormone binding globulin

A B S T R A C T

Background: This study aims to examine the role of hormones that are important for controlling female reproductive processes: the follicle-stimulating hormone (FSH), Sex binding globulin (SBHG), luteinizing hormone (LH), testosterone (T) and free testosterone (FT) levels as a prognostic marker among polycystic ovary syndrome (PCOS) patients, and their relationship with obesity.

Design and Methods: This study included one hundred samples of Iraqi patients aged between (25 and 40) years. A healthy BMI level is around (20-24.9) kg/m2, and around (25-29.9) kg/m2 is overweight. Then, when BMI is more than (30kg / m2), the woman is considered fat. The groups are collected from the Obstetrician and Gynecologist" in Karbala Hospital from December 2023 to March 2024. BMI, waist-to-hip ratio (WHR), LH, FSH, TT, FT, and SHBG levels were evaluated in each subject.

Results: A significant increase in LH (P=0.0001), FSH levels (p=0.05), LH/FSH ratio (P=0.0001), TT (p=0.025), and FT (p=0.0001) in PCOS patients compared to the control group. However, the SHBG level (p=0.0001) in PCOS patients compared to the control group was significantly diminished.

1. INTRODUCTION

The suffering environment of Iraq from acts of desecration is due to the wars that Iraq witnessed since 1990 and after 2003. This resulted in a large number of injuries and deaths due to radioactive materials and destructive chemicals. These calamities led to either infertility or cancer. Infertility is a disease. The reproductive system usually is defined as the failure clinically to chieve pregnancy after more than one year of uniform without protection sexual coition. In the last few years, infertility has been increased .[1]

In reproductive system the uterus is a most substantial organs and structures; this vacant muscular organ has a pear-shaped organ located between lower intestine and bladder. Uterus is composed from two parts, body and cervix; cervix is the lower portion of the uterus. The opening os is the vessel opening, which opens into the vagina and helps in the flowing out of the menstrual blood from the uterus to the vagina and leads to the uterus into two fallopian tubes. Alongside to this is ovary, which closes all stages of the tube. Ovary known is the egg-producing organ as contains 200,000 to 400,000 follicles. Figure 1 [2].

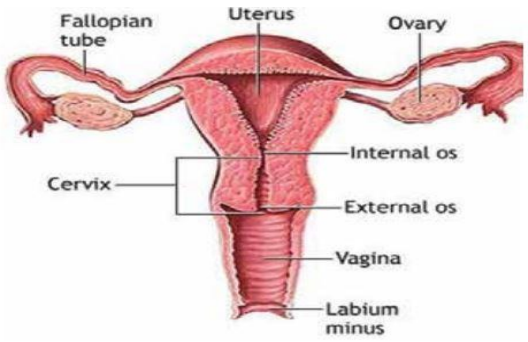

Figure 1. The reproductive system of women [2]

Infertile Women (IW) is defined as the way of a disturbance affecting contraceptive methods despite intercourse and without regular using of any means of despite the happening of pregnancy at least for six months [3]. Sanitize It was a general disturbance with an emotional impact effectiveness On the structural

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generative, described through the clinical pregnancy to the Inability of a The two partners after one year or more of regular Without protection sexual coition [4]. Because of the fight in Iraq around 2003, deaths with a large numbers of injuries because of the destructive chemicals and radioactive materials. The environment of Iraqi suffering from execution of opposition. People, which have endured of these overwhelming events as, well [2]. Failure to conceive a healthy baby after a year of continuous, Not protected sexual activity known as infertility. The World Health Organization (WHO) reports that this disorder is estimated to impact 1 in 6 persons worldwide and is acknowledged as a major reproductive health issue [5]. Numerous causes, including as medical disorders, environmental variables, and psychological ones, can lead to infertility. Due of the ongoing hostilities that have negatively harmed the ecosystem and public health, infertility rates in Iraq are especially alarming [6]. Healthcare services have been disrupted as a result of the ongoing unrest, which may make it more difficult for people to receive essential fertility treatments and reproductive health information. Additionally, as mental health is a major factor in the results of reproductive health, the psychological stress brought on by conflict might make infertility problems worse [7].

Infertility rates can also be influenced by environmental variables, such as pollution exposure and lifestyle changes [8]. Consequently, tackling infertility in Iraq necessitates a comprehensive strategy that takes into account the interaction of biological, environmental, and psychological elements, especially in light of the population's ongoing struggles [9]. Insulin resistance (IR) and type 2 diabetes mellitus (T2DM) are more likely to strike infertile women, especially if they are overweight or fat. The hormonal abnormalities and metabolic dysfunctions that frequently accompany infertility are primarily to blame for this association. One significant risk factor of T2DM is IR when a body's cells become less receptive to insulin [10]. Research shows that fat women have higher rates of IR than women who are not obese, which can increase the risk of developing DM and other metabolic problems [11]. Furthermore, this elevated risk is further compounded by the hormonal disorders linked to infertility, such as those observed in PCOS. IR, unpredictable menstrual periods, and high testosterone levels make PCOS the most common hormonal condition affecting women in their reproductive years [12]. The most widespread endocrine defect affecting women of Childbearing age is PCOS, which is closely attached to metabolic syndrome, insulin resistance, cardiovascular disease, and future risk of developing diabetes. In addition to having a higher risk of T2DM, PCOS in women also has a markedly increased risk of cardiovascular disorders, such as heart attacks and strokes [13]. For women who are experiencing infertility, the combination of obesity, insulin resistance, and hormone abnormalities produces a complex health landscape that requires close monitoring and management of their general health. Different studies have reported an increase in the number of follicle cells in PCOS patients. The Impaired susceptibility to apoptosis in mature follicular cells leads to high abnormal follicle development. Responsibility is attributed to the tendency of cysts on ovaries in patients with infertility [1]. This study aims to highlight the role of hormones that are important for controlling the reproductive processes of females: follicle-stimulating hormone (FSH), Sex hormone binding globulin (SHBG), testosterone, free testosterone, and luteinizing hormone (LH), levels as a prognostic marker among women with PCOS and their relation with obesity, infertility, and other symptoms of the disease in the city of Karbala.

2. MATERIAL AND METHODS

This study was conducted during the period from (Dec.2023 to Mar.2024). A case-control study was designed; 100 individuals, 50 patients, and 50 healthy subjects were the control group, aged from (20) to (45) years. The diagnosis is based on the numerous surveys of PCOS biomarkers, presentation long-established by UTS, clinical history, and Normal level BMI is between (20-24.9) kg/m2. However, the overweight is around (25-29.9) kg/m2. Women who have a BMI ≥ 30kg / m2 are treated as obese. Groups are collected from the Obstetricians and Gynecologists" in Karbala Hospital.

3. STATISTICAL ANALYSIS

Data analysis was performed Using the Statistical Package for the Social Sciences (SPSS) version (23.0 with results expressed as (mean ± standard deviation) SD [14].

3. RESULTS AND DISCUSSION

The clinical features of PCOS patients with infertile women are demonstrated in Table 1.

The Elevation in LH is a repeated PCOS symptom, while it isnot needed for diagnosis. LH enhances ovarian androgen production, ovulation induction, luteinization, and primary agent participation in hyperandrogenism in patients with PCOS. LH enhances the androgens primarily in the ovarian theca cells, where LH receptors are located [11]. High levels of LH concentrations show a relation with further severe kinds of PCOS. Preceding research confirms the positive relationship between ovarian volume and follicle number and high concentrations of LH in women with PCOS, which is linked together with the most serious menstrual disorder and a high probability of Inability to conceive. The PCOS

women with hypersecretion of LH also reflect the severity conditions [15].

A relative deficiency in FSH impairs follicular development [16]. It impairs estrogen and FSH synthesis due to increased LH pulse frequency so that ovulation and follicle growth are inhibited, contributing to the formation of polycystic ovaries in women [13]. Steadily quick (GnRH) pulsing, Which favors pituitary LH over synthesis of FSH and leads to an increase in the LH level and, therefore, varied LH / FSH ratios identical to PCOS, is believed to be a feature of the neuroendocrine condition. The development in the Follicular is restrained by lowering the level of FSH, with high LH levels enhancing ovarian androgen production [14]. FSH is produced by the hypothalamus in the pituitary gland, which causes a difference in hormonal levels in affected women.[15]

The Rotterdam Agreement approved that, to diagnose hyperandrogenism in PCOS women, the circulatory FT tests should be used instead of serum TT [16]. One of the most common causes of women's infertility is PCOS [20]. The blood level of TT is directly related to the rise in LH levels [17]. This study agrees with Das et al. (2014) that both groups have a positive association between serum PCOS, age, BMI, and WHR [18]. Mean LH, BMI, and LH/ FSH ratio were elevated in the PCOS population. Also this study is showing the strength correlation between risk of PCOS and SHBG levels in reproductive aged females. A low level of serum SHBG associated with the complexity and long-term prediction of PCOS has a vital role in causing the disease [19]. The SHBG concentration in PCOS-infertile women is usually low because these women have risen androgen levels and ordinarily present with compensatory IR and HA. Moreover, androgens and insulin inhibit the synthesis and secretion of SHBG in the liver.

The association between SHBG and BMI levels in both groups is negative, as linear regression analysis shows. It has recently been recognized that PCOS does not only appear as a classic phenotype associated with obesity. The same applies to women who are underweight or have a normal body. In women of normal or underweight with PCOS [20]. Resistance of Insulin associated with PCOS upgrade with suitable treatment of the disease. Nevertheless, relationships between insulin–BMI, SHBG– SHBG–BMI, and insulin were investigated in a previous study [21]. Similar correlations in both PCOS groups in insulin BMI, BMI, and SHBG. with increased BMI and decreased SHBG levels, fasting insulin levels elevated with higher BMI. These connections were researched previously. However, the finding is that the insulin levels of SHBG did not show reverse linear relevance in women with PCOS with normal weight of the body. Thus, this leads us to conclude that SHBG is not compatible with describing the metabolism of carbohydrates and changes in levels of serum insulin in normal/slim weight women PCOS [22].

TABLE 1. The features of the 50 patients with (PCOS) infertile women and 50 control women

Variables	Groups		
	PCOS infertile women Patients group, No= 50 (Mean±SD)	Healthy group. No= 50 (Mean±SD)	P-Value
Age (25-40) Years	20.21± 5.67	20.34± 7.16	0.125
BMI(kg/m²)	19.66 ± 1.19	13.62 ± 1.04	0.002
18.9-24.9:BMI	10(12%)	90(100%)	
BMI:25-29.9	25.(38%)	-	
BMI:≥30	25(50%)	-	
WHR	1.08± 0.06	0.34± 0.05	0.001
Female infertility No (%)	33(66%)	-	-

TABLE 2. Biochemical Parameters registered in healthy groups and patients

Parameter	(Mean±SD) PCOS infertile women (n= 50)	(Mean±SD) Healthy group. No= 50	P-Value
LH (m.IU/mL)	13.02±3.16	4.95±2.18	0.0001
FSH (m.IU/mL)	6.37±3.01	5.29±2.43	0.05

FSH/LH	2.28±0.69	0.804±0.23	0.0001
TT (ng/mL)	2.49±0.92	1.01±0.37	0.025
FT (p g /mL)	13.14±2.03	3.14±3.05	0.0001
SHBG (ng/mL)	51.72±5.34	22.45±33.64	0.0001

TABLE 3. The Correlation of SHBG level in serum with biochemical parameters and anthropometric in PCOS infertile women group

Biochemical parameters	r = Correlation	P-Value
LH (m.IU/mL)	-0.204	0.073
FSH (m.IU/mL)	-0.226	0.065
LH/FSH	-0.194	0.109
TT (ng/mL)	-0.129	0.183
FT (ng/mL)	-0.317	0.001
BMI (Kg/m2)	-0.291	0.035
Age (Years)	-0.411	0.001

4. CONCLUSION

Prophecy biomarkers are used to diagnose patients at risk of getting early damage, so it is necessary to monitor and target therapy protocol carefully. In general, SHBG is considered to be an interesting biochemical marker for patient classification and diagnosis of PCOS women at risk of organ damage during (the 25-40) years of the disease. A low level of serum SHBG is associated with the complexity and long-term prediction of PCOS, which plays a vital role in its pathogenesis. This study discusses the connection between SHBG, PCOS, and hormonal levels.

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Arabic Abstract

خلفية الدراسة: تهدف هذه الدراسة إلى فحص دور الهرمونات المهمة في التحكم في العمليات التناسلية الأنثوية: هرمون تحفيز الجريب (FSH)، وهرمون ربط الجنس (SBHG)، وهرمون اللوتين (LH)، وهرمون التستوستيرون (T) ومستويات التستوستيرون الحر (FT) كمؤشر تشخيصي بين مرضى متلازمة تكيس المبايض (PCOS)، وعلاقتهن بالسمنة.

التصميم والطرق: شملت هذه الدراسة مائة عينة من المرضى العراقيين الذين تتراوح أعمارهم بين (25 و 40) عامًا. يبلغ مستوى مؤشر كتلة الجسم (BMI) الصحي حوالي (20-24.9) كجم / م 2، وحوالي (25-29.9) كجم / م 2 يكون زيادة الوزن. ثم عندما يكون مؤشر كتلة الجسم أكثر من (30 كجم / م 2)، تعتبر المرأة بدينة.

تم جمع المجموعات من "قسم أمراض النساء والولادة" في مستشفى كربلاء من ديسمبر 2023 إلى مارس 2024. تم تقييم مؤشر كتلة الجسم ونسبة محيط الخصر إلى الورك (WHR) ومستويات LH و FSH و TT و FT و SHBG في كل موضوع.

النتائج: لوحظ زيادة كبيرة في مستويات (P = 0.0001) LH و (p = 0.05) FSH ونسبة (P = 0.0001) LH / FSH و (p = 0.025) TT و (p = 0.0001) FT لدى مرضى PCOS مقارنة بالمجموعة الضابطة. ومع ذلك ، انخفض مستوى (p = 0.0001) SHBG بشكل كبير لدى مرضى PCOS مقارنة بالمجموعة الضابطة.

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A New Subclass of Analytic Functions on Unit Disk Defined by Using Integral Operator

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P A P E R I N F O

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A B S T R A C T

The objective of this paper is to construct a new subclass of univalent analytic functions using integral operator inside an open unit disk U . The method for proving these theorems, which are utilized to derive new findings on this topic, relies on the Lemma 1.1 and Lemma 1.2 that are stated in this study. The new findings of coefficient bounds for new subclass were used to obtain the theorems of The Growth and distortion , Extreme points and Hadamared product of functions. The novelty of this work adds to the body of knowledge already available on the convolution of univalent analytic function and integral operator.

1. INTRODUCTION

Complex analysis is a rich and multifaceted field with roots in the eighteenth century. It has applications not just to other disciplines of analysis but also to other fields of mathematics and science as a whole. The theory of conformal representation and the geometric function theory of analytic functions are two significant areas of complex analysis. The latter is developed at the turn of the twentieth century and deals with geometrical characteristic of analytic functions; it is still important area of study today. The writings of Bieberbach in 1916 [1] about coefficient problem of univalent analytic functions are among the first noteworthy studies that address subjects from this realm. In $k-$dimensional complex coordinate space, he was able to drive certain results regarding the range of possible values at the point $d_1, d_2, \cdots d_k$. The best value of n_k is k where $\mathbb{S}(\varpi) = \varpi + d_2\varpi^2 + \cdots d_k\varpi^k + \cdots$, $|d_k| \leq n_k$; this equality holds if and only if $\mathbb{S}(\varpi) = \frac{\varpi}{(1-\varpi)^2}$ or one of its rotation. This statement is known as the Biberbach conjecture. In 1923 Lowner [2] proved the Biberbach conjecture for $n = 3$. Finally, in 1985 De Branges [3] proved the Biberbach conjecture for all coefficients with the help of hypergeometric functions. This affirmation elevated the field of geometric function theory to one of the ever growing areas of possible research. Since the Biberbach conjecture was difficult to settle, several authors have considered classes defined by geometric conditions. Notable among them are the classes of starlike functions, convex functions and closed to convex functions. This problem persisted as a difficulty for many years, spurring the creation of intricate and new research techniques that laid the groundwork for the subsequent production of hundreds of articles on the subject. In the area of coefficient bounds for univalent analytic functions on unit disk, there are two research gaps. The first is numerical and computational in nature. As computational tools become more powerful, effective numerical method for computing coefficient bounds must be developed. This can involve using optimization techniques to enhance the bounds, which will help us understand the geometric properties of univalent function better. The second area of research gap is the extension of the study of

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coefficient bounds to univalent analytic functions in higher-dimensional spaces, like the unit ball or unit polydisk in $\mathbb{C}^n$. The first research gap is the subject of this paper, which aims to create a new subclass for this topic and apply an integral operator technique to improve the coefficient bounds. Now, let $\mathcal{M}$ be the class of functions given by

$$\mathbb{S}(\varpi) = \varpi + \sum_{k=2}^{\infty} d_k\, \varpi^k, \tag{1.1}$$

Which in the open unit disk $U = \{\varpi \in \mathbb{C}: |\varpi| < 1\}$ are analytic and univalent

If $\mathbb{S}$ is given by (1.1) and $\mathbb{T}$ is defined by

$$\mathbb{T}(\varpi) = \varpi + \sum_{k=2}^{\infty} b_k\, \varpi^k, \tag{1.2}$$

is in $\mathcal{M}$, then the convolution (Hadamard product) of $\mathbb{S}$ and $\mathbb{T}$ in U is defined by

$$(\mathbb{S} * \mathbb{T})(\varpi) = \varpi + \sum_{k=2}^{\infty} d_k\, b_k \varpi^k, \tag{1.3}$$

For $\mathbb{S}$ in $\mathcal{M}$ is starlike of order $\varrho (0 \le \varrho \le 1)$ if $Re\left\{\frac{\varpi \mathbb{S}'}{\mathbb{S}}\right\} > \varrho$ and is convex of order ϱ if $Re\left\{1 + \frac{\varpi \mathbb{S}''}{\mathbb{S}'}\right\} > \varrho$, respectively symbolizes by $\mathbb{S} \in \mathcal{S}^*_{\mathcal{M}}(\varrho)$ and $\mathbb{S} \in \mathcal{K}_{\mathcal{M}}(\varrho)$ for $|\varpi| < 1$.

For $\mathbb{S} \in \mathcal{M}$, the following integral operator that follows was defined by Al-Shaqsi[4]:

$$L^{\ell}_{\delta} = (1+\delta)^{\ell} \Phi_{\ell}(\delta; \varpi) * \mathbb{S}(\varpi)$$

$$= -\frac{(1+\delta)^{\ell}}{\Gamma(\ell)} \int_0^1 t^{\delta-1} log\left(\frac{1}{t}\right)^{\ell-1} \mathbb{S}(\varpi)\, dt, \quad (\delta > 0, \ell > 1, \varpi \in U) \tag{1.4}$$

Where Γ standarts for the usual gamma function, $\Phi_{\ell}(\delta; \varpi)$ is the well-known generalization of the Riemann-zeta and polylogarithm functions, or the sth polylogarithm function, given by

$$\Phi_{\ell}(\delta; \varpi) = \sum_{k=2}^{\infty} \frac{\varpi^k}{(k+\delta)^{\ell}}$$

Where all terms other than $k + \delta = 0$ is eliminated. Also, the Koebe function is $\Phi_{-1}(0; \varpi) = \sum_{k=1}^{\infty} \frac{\varpi}{(k+\delta)^{\ell}}$

It can be said that the series expansion of the operator $L^{\ell}_{\delta}\mathbb{S}(\varpi)$ given by (1.4) have the following expansions:

$$L^{\ell}_{\delta}\mathbb{S}(\varpi) = \varpi + \sum_{k=2}^{\infty} \left(\frac{1+\delta}{k+\delta}\right)^{\ell} d_k \varpi^k$$

A new subclass $\mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ of $\mathbb{S} \in \mathcal{M}$ is now defined, and it meets the conditions listed below:

$$Re\left\{\frac{\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)'' + \gamma\varpi^2\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)'''}{\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)' + \gamma z\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)''}\right\} \ge \tau\left|\frac{\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)'' + \gamma z^2\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)'''}{\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)' + \gamma z\left(L^{\ell}_{\delta}\mathbb{S}(\varpi)\right)''} - 1\right| + \epsilon \tag{1.5}$$

$$(\delta > 0, \ell > 1, \tau \ge 0, 0 \le \epsilon \le 1, 0 \le \gamma < 1, \varpi \in U)$$

Univalent functions for various subclasses and subjects were examined by several authors, such [5], [6], [7], [8], [9], [10][11], and [12].

The current study aims to develop new results regarding the characteristic of the geometric function of $\mathbb{S} \in \mathcal{M}$ in $\mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ by applying the two lemma mentioned below:

Lemma(1.1)[13]: Let $\mathcal{Y} = \mathfrak{p} + i\mathfrak{q}$ and σ is real number then $Re(\mathcal{Y}) \ge \sigma$ if and only if $|\mathcal{Y} - (1+\sigma)| \le |\mathcal{Y} + (1-\sigma)|$.

Lemma(1.2)[13]: Let $\mathcal{Y} = \mathfrak{p} + i\mathfrak{q}$ and σ, γ are real numbers then $Re(\mathcal{Y}) \ge \sigma|\mathcal{Y} - 1| + \gamma$ if and only if $Re\{\mathcal{Y}(1 + \sigma e^{i\phi}) - \sigma e^{i\phi}\} > \gamma$.

2. COEFFICIENT ESTIMATES

The next theorem provides us with a necessary and sufficient condition for $\mathbb{S} \in \mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$

Theorem(2.1): Let $\mathbb{S}$ be defined by (1.1), then $\mathbb{S} \in \mathcal{D}(\delta, \ell, \gamma, \beta, \epsilon)$ if and only if

$$\sum_{k=2}^{\infty} k\big((k-\epsilon) + \tau(k-1)\big)[1 + \gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell} d_k \le (1-\epsilon) \tag{2.1}$$

where

$$\delta > 0, \ell > 1, \tau \geq 0, 0 \leq \epsilon < 1, 0 \leq \gamma < 1, \varpi \in U$$

Proof: by (1.5), we get

$$Re\left\{\frac{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'' + \gamma\varpi^2\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'''}{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''}\right\} \geq \tau\left|\frac{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'' + \gamma\varpi^2\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'''}{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''} - 1\right| + \epsilon$$

Lemma(1.2) then give us

$$Re\left\{\frac{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'' + \gamma\varpi^2\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'''}{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''}\left(1 + \tau e^{i\vartheta}\right) - \tau e^{i\vartheta}\right\} \geq \epsilon$$

$-\pi < \vartheta \leq \pi$, or in the same way,

$$Re\left\{\frac{\left(\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'' + \gamma\varpi^2\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'''\right)(1+\tau e^{i\vartheta})}{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''} - \frac{\tau e^{i\vartheta}\left(\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''\right)}{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''}\right\} \geq \epsilon \qquad (2.2)$$

Let

$$F(\varpi) = \left(\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + (1+2\gamma)\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'' + \gamma\varpi^2\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'''\right)(1+\tau e^{i\vartheta}) - \tau e^{i\vartheta}\left(\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''\right)$$

and $E(\varpi) = \left(L_\delta^\ell \mathbb{S}(\varpi)\right)' + \gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''$

Lemma(1.1) states that (2.2) is equal to

$$|F(\varpi) + (1-\epsilon)E(\varpi)| \geq |F(\varpi) - (1+\epsilon)E(\varpi)| \quad \text{for } 0 \leq \epsilon < 1$$

But

$$\left|\begin{array}{c}\left[1 + \sum_{k=2}^{\infty} k\{1 + (1+2\gamma)(k-1) + \gamma(k-1)(k-2)\}\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right](1+\tau e^{i\vartheta}) - \\ \tau e^{i\vartheta}\left[1 + \sum_{k=2}^{\infty} k\{1+\gamma(k-1)\}\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right] + \\ (1-\epsilon)\left[1 + \sum_{k=2}^{\infty}\{k + \gamma k(k-1)\}\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right]\end{array}\right|$$

$$= \left|\begin{array}{c}\left[(2-\epsilon) + \sum_{k=2}^{\infty} k(1-\epsilon+k)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right] + \\ \tau e^{i\vartheta}\left[\sum_{k=2}^{\infty} k(k-1)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right]\end{array}\right|$$

$$\geq (2-\epsilon) - \sum_{k=2}^{\infty} k(1-\epsilon+k)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k|\varpi|^{k-1} - \tau\sum_{k=2}^{\infty} k(k-1)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k|\varpi|^{k-1}$$

Also

$$|F(\varpi) - (1+\epsilon)E(\varpi)| =$$

$$\left|\begin{array}{c}\left[1 + \sum_{k=2}^{\infty} k\{1 + (1+2\gamma)(k-1) + \gamma(k-1)(k-2)\}\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right](1+\tau e^{i\vartheta}) - \\ \tau e^{i\vartheta}\left[1 + \sum_{k=2}^{\infty} k\{1+\gamma(k-1)\}\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right] - \\ (1+\epsilon)\left[1 + \sum_{k=2}^{\infty}\{k + \gamma k(k-1)\}\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right]\end{array}\right|$$

$$= \left|\begin{array}{c}\left[(-\epsilon) + \sum_{k=2}^{\infty} k(k-(1+\epsilon))[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right] + \\ \tau e^{i\vartheta}\left[\sum_{k=2}^{\infty} k(k-1)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k\varpi^{k-1}\right]\end{array}\right|$$

$$\leq \epsilon + \sum_{k=2}^{\infty} k(k-(1+\epsilon))[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k|\varpi|^{k-1} + \tau\sum_{k=2}^{\infty} k(k-1)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k|\varpi|^{k-1}$$

Consequently

$$|F(\varpi) + (1-\epsilon)E(\varpi)| - |F(\varpi) - (1+\epsilon)E(\varpi)| \geq 2(1-\epsilon) - \sum_{k=2}^{\infty} 2k(k-\epsilon)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k|\varpi|^{k-1} - \tau\sum_{k=2}^{\infty} 2k(k-1)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k|\varpi|^{k-1} \geq 0$$

That is the same as

$$\sum_{k=2}^{\infty} k\left((k-\epsilon) + \beta(k-1)\right)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^\ell d_k \leq (1-\epsilon)$$

Conversely, if (2.1) is true, then we need to demonstrate

$$Re\left\{\frac{\begin{pmatrix}(1+\beta e^{i\vartheta})\begin{pmatrix}\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' +(1+2\gamma)\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'' +\\ \gamma\varpi^2\left(L_\delta^\ell \mathbb{S}(\varpi)\right)'''\end{pmatrix}-\\ \tau e^{i\vartheta}\left(\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' +\gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''\right)\end{pmatrix}}{\left(L_\delta^\ell \mathbb{S}(\varpi)\right)' +\gamma\varpi\left(L_\delta^\ell \mathbb{S}(\varpi)\right)''}\right\}\geq \epsilon$$

When selecting values for ϖ on the positive real axis, where $0\leq \varpi = r < 1$, the inequality shown above decreases to

$$Re\left\{\frac{(1-\epsilon e^{i\vartheta})+\sum_{k=2}^{\infty} k\left((k-\epsilon e^{i\vartheta})+\beta(k-1)e^{i\vartheta}\right)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell} d_k r^{k-1}}{1+\sum_{k=2}^{\infty}(k+\gamma k(k-1))\left(\frac{1+\delta}{k+\delta}\right)^{\ell} d_k r^{k-1}}\right\}\geq 0$$

Since $Re\left(-e^{i\vartheta}\right)\geq -\left|e^{i\vartheta}\right| = -1$, the inequality above becomes

$$Re\left\{\frac{(1-\epsilon)+\sum_{k=2}^{\infty} k\left((k-\epsilon)+\tau(k-1)\right)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell} d_k r^{k-1}}{1+\sum_{k=2}^{\infty}(k+\gamma k(k-1))\left(\frac{1+\delta}{k+\delta}\right)^{\ell} d_k r^{k-1}}\right\}\geq 0$$

Letting $r\to 1^{-}$, the intended conclusion is reached.

Corollary (2.2): Let $\mathbb{S}(\varpi)\in \mathcal{D}(\delta,\ell,\gamma,\tau,\epsilon)$, then

$$\sum_{k=2}^{\infty} d_k \leq \frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} \qquad (2.3)$$

and

$$\sum_{k=2}^{\infty} k d_k \leq \frac{(1-\epsilon)}{\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} \qquad (2.4)$$

Next, as seen below, the sharpness is satisfied from(2.3)

$$T(\varpi) = \varpi + \sum_{k=2}^{\infty}\frac{(1-\epsilon)}{k\left((k-\epsilon)+\tau(k-1)\right)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}}\varpi^k$$

3. GROWTH AND DISTORTION THEOREM

Here is the growth and distortion theorems for $\mathbb{S}\in \mathcal{D}(\delta,\ell,\gamma,\tau,\epsilon)$ that can be obtained

Theorem(3.1): Let $\mathbb{S}(\varpi)$ defined by (1.1) be in the subclass $\mathcal{D}(\delta,\ell,\gamma,\tau,\epsilon)$, then

$$r-\frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r^2 \leq |\mathbb{S}(\varpi)| \leq r+\frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r^2,$$

$|\varpi| = r < 1.$

For the function $\mathbb{S}(\varpi)$ given by

$$\mathbb{S}(\varpi) = \varpi + \frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}}\varpi^2,$$

the result is sharp.

Proof: Let $\mathbb{S}(\varpi)\in \mathcal{D}(\delta,\ell,\gamma,\tau,\epsilon)$ then by(2.3) in **Corollary (2.2),** we have

$$\sum_{k=2}^{\infty} d_k \leq \frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}}$$

Hence

$$|\mathbb{S}(\varpi)| \leq |\varpi| + \sum_{k=2}^{\infty} d_k |\varpi|^k = r + r^2\sum_{k=2}^{\infty} d_k \leq r+\frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r^2 \qquad (3.2)$$

Similarly

$$|\mathbb{S}(\varpi)| \geq |\varpi| - \sum_{k=2}^{\infty} d_k |\varpi|^k = r - r^2\sum_{k=2}^{\infty} d_k \geq r-\frac{(1-\epsilon)}{2\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r^2 \qquad (3.3)$$

from bound (3.2) and (3.3), we get (3.1). ■

Theorem(3.2): Let the function $\mathbb{S}(\varpi)$ defined by (1.1) be in the subclass $\mathcal{D}(\delta,\ell,\gamma,\tau,\epsilon)$, then

$$1-\frac{(1-\epsilon)}{\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r \leq |\mathbb{S}'(\varpi)| \leq 1+\frac{(1-\epsilon)}{\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r \qquad (3.4)$$

$|\varpi| = r < 1.$

For the function $\mathbb{S}(\varpi)$ given by

$$\mathbb{S}(\varpi) = \varpi + \frac{(1-\epsilon)}{\left((2-\epsilon)+\tau\right)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}}\varpi^2,$$

the result is sharp

Proof: Let $\mathbb{S}(\varpi) \in \mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ then by(2.4) in **Corollary (2.2),** we have

$$\sum_{k=2}^{\infty} k d_k \leq \frac{(1-\epsilon)}{\big((2-\epsilon)+\tau\big)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}}$$

Hence

$$|\mathbb{S}'(\varpi)| \leq |1| + \sum_{k=2}^{\infty} k d_k |\varpi^k|^{k-1} = 1 + r\sum_{k=2}^{\infty} k d_k \leq 1 + \frac{(1-\epsilon)}{\big((2-\epsilon)+\tau\big)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r \qquad (3.5)$$

Similarly

$$|\mathbb{S}'(\varpi)| \geq |1| - \sum_{k=2}^{\infty} k d_k |\varpi|^{k-1} = 1 - r\sum_{k=2}^{\infty} k d_k \geq 1 - \frac{(1-\epsilon)}{\big((2-\epsilon)+\tau\big)[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}} r \qquad (3.6)$$

from bound (3.5) and (3.6), we get (3.1). ■

4. EXTREME POINTS

The extreme points theorem for $\mathbb{S} \in \mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ is obtained in the following theorem

Theorem(4. 1): Let $\mathbb{S}_1(\varpi) = \varpi$ and $\mathbb{S}_k(\varpi) = \varpi + \frac{(1-\epsilon)}{k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}} \varpi^k, for\ k = 2,3, \ldots$ then $\mathbb{S} \in \mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ if and only if it is able to be stated as

$$\mathbb{S}(\varpi) = \sum_{k=1}^{\infty} \mathcal{T}_k\, \mathbb{S}_k(\varpi)$$

where $(\mathcal{T}_k \geq 0\ and\ \sum_{k=1}^{\infty} \mathcal{T}_k = 1\ \ or\ 1 = \mathcal{T}_1 + \sum_{k=2}^{\infty} \mathcal{T}_k)$

proof: Let

$$\mathbb{S}(\varpi) = \sum_{k=1}^{\infty} \mathcal{T}_k\, \mathbb{S}_k(\varpi) = \varpi + \sum_{k=2}^{\infty} \frac{(1-\epsilon)}{k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}} \mathcal{T}_k \varpi^k$$

then, from **Theorem(2.1)** , we obtain

$$\sum_{k=2}^{\infty} k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell} \times \frac{(1-\epsilon)}{k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}} \mathcal{T}_k = (1-\epsilon)\sum_{k=2}^{\infty} \mathcal{T}_k = (1-\epsilon)(1-\mathcal{T}_1) \leq (1-\alpha)$$

It follows that $\mathbb{S} \in \mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ in light of **Theorem(2.1)** Conversely, let $\mathbb{S} \in \mathcal{D}(\delta, \ell, \gamma, \tau, \epsilon)$ then

$$d_k \leq \frac{(1-\epsilon)}{k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}}$$

by setting

$$\mathcal{T}_k = \frac{k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}}{(1-\epsilon)} d_k, for\ k = 2,3, \ldots$$

and

$$\mathcal{T}_1 = 1 - \sum_{k=2}^{\infty} \mathcal{T}_k$$

then

$$\mathbb{S}(\varpi) = \varpi + \sum_{k=2}^{\infty} d_k\, \varpi^k = \varpi + \sum_{k=2}^{\infty} \frac{(1-\epsilon)}{k\big((k-\epsilon)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}} \mathcal{T}_k \varpi^k = \mathcal{T}_1 \varpi + \sum_{k=2}^{\infty} \mathcal{T}_k \mathbb{S}_k(\varpi) = \sum_{k=1}^{\infty} \mathcal{T}_k \mathbb{S}_k(\varpi),$$

this complete the proof.■

5. HADAMARD PRODUCT

Let $\mathbb{S}_j \in \mathcal{M}$ given by

$$\mathbb{S}_j(\varpi) = \varpi + \sum_{k=2}^{\infty} d_{k,j}\, \varpi^k, \qquad j = 1,2,\ \varpi \in U \qquad (5.1)$$

Then the Hadamard product of $\mathbb{S}_j \in \mathcal{M}$ for $j = 1,2$ is defined by

$$(\mathbb{S}_1 * \mathbb{S}_2)(\varpi) = \varpi + \sum_{k=2}^{\infty} \left(\prod_{j=1}^{2} d_{k,j} \right) \varpi^k,$$

The following theorem includes one of our main findings.

Theorem(5. 1): If $\mathbb{S}_j(\varpi) \in \mathcal{D}\big(\delta, \ell, \gamma, \tau, \epsilon_j\big)$ for $j = 1,2$, then $(\mathbb{S}_1 * \mathbb{S}_2)(\varpi) \in \mathcal{D}(\delta, \ell, \gamma, \tau, \psi)$

as well as

$$\psi \leq 1 - \frac{\prod_{j=1}^{p=2}(1-\epsilon_j)(\tau+2)}{[1+\gamma]\left(\frac{1+\delta}{2+\delta}\right)^{\ell}\left(\left(\prod_{j=1}^{p=2}(2-\epsilon_j)+\tau\right)\right) - \prod_{j=1}^{p=2}(1-\epsilon_j)}$$

Proof: In order to prove $(\mathbb{S}_1 * \mathbb{S}_2)(\varpi) \in \mathcal{D}(\delta, \ell, \gamma, \tau, \psi)$ it is enough to show

$$\sum_{k=2}^{\infty} \frac{\left(k\big((k-\epsilon_j)+\tau(k-1)\big)[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\right)}{(1-\epsilon_j)} d_{k,j} \leq 1 \qquad (5.2)$$

For $j = 1,2,$ the Cauchy-Schwarz inequality is used to get

$$\sum_{k=2}^{\infty}[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\sqrt{\prod_{j=1}^{p=2}\left(\frac{\left(k\left((k-\epsilon_j)+\right)\right)}{(1-\alpha_j)}d_{k,j}\right)} \leq 1 \quad (5.3)$$

To prove $p = 2$, our task is to determine the largest ψ so that

$$\sum_{k=2}^{\infty}\frac{\left(k((k-\psi)+\tau(k-1))[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\right)}{(1-\psi)}d_{k,j} \leq 1 \quad (5.4)$$

Alternatively, it is equivalent to

$$\sqrt{d_{k,j}} \leq \frac{(1-\psi)}{\left(k((k-\psi)+\tau(k-1))\right)}\frac{\sqrt{\left(k\left(\prod_{j=1}^{p=2}(k-\epsilon_j)+\tau(k-1)\right)\right)}}{\sqrt{\prod_{j=1}^{p=2}(1-\epsilon_j)}} \quad (5.5)$$

Moreover, that is

$$\sqrt{d_{k,1}d_{k,2}} \leq \frac{(1-\psi)}{\left(k((k-\psi)+\tau(k-1))\right)}\sqrt{\prod_{j=1}^{p=2}\frac{\left(k\left((k-\epsilon_j)+\tau(k-1)\right)\right)}{(1-\epsilon_j)}} \quad (5.6)$$

Finding the largest ψ requires us to go beyond (5.3) in the following manner

$$\frac{\left(k((k-\psi)+\tau(k-1))\right)}{(1-\psi)} \leq [1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\prod_{j=1}^{p=2}\left(\frac{\left(k\left((k-\epsilon_j)+\tau(k-1)\right)\right)}{(1-\epsilon_j)}\right) \quad (5.7)$$

which is the same as

$$\psi \leq 1 - \frac{\prod_{j=1}^{p=2}(1-\epsilon_j)(\tau(k-1)+k)}{[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\left(\left(\prod_{j=1}^{p=2}(k-\epsilon_j)+\tau(k-1)\right)\right)-\prod_{j=1}^{p=2}(1-\epsilon_j)}$$

$$\psi = 1 - \frac{\prod_{j=1}^{p=2}(1-\epsilon_j)(\tau(k-1)+k)}{[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\left(\left(\prod_{j=1}^{p=2}(k-\epsilon_j)+\tau(k-1)\right)\right)-\prod_{j=1}^{p=2}(1-\epsilon_j)} \quad (5.8)$$

Let us now assume that

$$\Phi(k) = 1 - \frac{\prod_{j=1}^{p=2}(1-\epsilon_j)(\tau(k-1)+k)}{[1+\gamma(k-1)]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\left(\left(\prod_{j=1}^{p=2}(k-\epsilon_j)+\tau(k-1)\right)\right)-\prod_{j=1}^{p=2}(1-\epsilon_j)} \quad (5.9)$$

Since $\Phi'(k) \geq 0$ for $(k \geq 2)$ these produces

$$\psi \leq \Phi(2) = 1 - \frac{\prod_{j=1}^{p=2}(1-\epsilon_j)(\tau+2)}{[1+\gamma]\left(\frac{1+\delta}{k+\delta}\right)^{\ell}\left(\left(\prod_{j=1}^{p=2}(2-\epsilon_j)+\tau\right)\right)-\prod_{j=1}^{p=2}(1-\epsilon_j)} \quad (5.10)$$

thus, this theorem's proof is finished.■

6. CONCLUSION

. In the present paper, a new subclass of univalent analytic function convolution with integral operator on an open unit disk is calculated the coefficient bounds, Growth and distortion theorems. Extreme points and Hadamared product are also obtained for this new subclass. The application of differential equations of order m may benefit from the generalization of this new subclass to a new subclass of multivalent analytic functions that involve a higher derivatives operator in the future.

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Arabic Abstract

الهدف في هذا البحث هو تقديم اصناف جزئية جديدة من الدوال التحليلية احادية التكافؤ المعرفة على قرص الوحدة المفتوح، وطريقة اثبات المبرهنات لإيجاد نتائج جديدة في هذا الموضوع معتمدة على Lemma 1.1 و Lemma 1.2 التي ذكرت في هذه الدراسة. النتائج الجديدة لقيود المعاملات لهذا الصنف الجزئي الجديد استخدمت لإيجاد مبرهنات النمو والتشوه، النقاط المتطرفة وضرب الالتواء للدوال. تضيف حداثة هذا العمل الى المجموعة المتاحة بالفعل حول الالتواء بين الدوال احادية التكافؤ والمؤثر التكاملي.

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A Study on Optimal Approximation of Functional Subsets within Real Normed Spaces

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P A P E R I N F O

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A B S T R A C T

The optimal approximation of functional subsets within standard spaces facilitates data modeling and management of linear and nonlinear systems. In this paper, the best approximation in a real standard linear space X is described by the Kolmogorov theorem. In addition, the concepts of proximal set, smooth space, sun, sun point, and their relationship with the Kolmogorov condition are discussed. Finally, the effectiveness of using the best approximation in practical situations to achieve high accuracy in the computation of standard linear spaces is highlighted.

NOMENCLATURE	
W	a topological space that is compact and Hausdorff
W(T)	the space of real continuous functions on T
x	Real Normed Spaces
T	T is a compact Hausdorff topological space
crit	Critical Point

1. INTRODUCTION

In recent decades, there has been an increasing need to study the importance of best approximation within the field of functional analysis and in particular within the field of standard linear spaces, [1-4]. This study seeks to provide a detailed description of the best approximation in real normed linear space X through a specialized theorem that highlights the main aspect of the theoretical trends. Furthermore, the fundamental concepts within this trend related to close sets, suns and sun points, how these concepts are interconnected, and their importance for Kolmogorov's condition are investigated [5]. This provides comprehensive coverage of approximation theory, practical effect, and its extension into real standard spaces. The following will be the setting for this paper: We refer to W to be as a topological space that is compact and Hausdorff [6]. W(T) will denote the space of real continuous functions on T unless explicitly stated, and the complex space W(T) is also being considered. The uniform standard is installed in the spaces W(T). Let B be a non-empty subset of W(T). The uniform norm is defined by nown as the distance between u and B. Therefore,

$$\| u \| = \max_{t \in \mathcal{T}} |u(t)| \quad \text{for all } u \in W(T) , \tag{1}$$

And

$$d(u , B) = \inf_{h \in B} \| u - h \| \quad \text{for} \quad u \in W(\mathcal{T}) , \tag{2}$$

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It is k

$P_B(u) = \{h \in B : \| u - h \| = d(u, B)\}$,	(3)

As a collection of the best approximations of u from B. Now given u ∈ W($\mathcal{T}$), the main problem is finding an element h_0 ∈ B such that $\| u - h_0 \| \leq \| u - h \|$, for all h ∈ B. Such an element, if present, is called the best approximation element (closest element) to u from B. The number $\| u - h_0 \|$ is then the distance from u to B and $d(u, B) = \| u - h_0 \|$. The best approximation when $P_B(u)$ is non-empty? (the members of $P_B(u)$ will be called best approximation to u from B), that is, which properties of B and the space ensures that $P_B(u) \neq \emptyset$ for each u ∈ W($\mathcal{T}$), in this case, B is said to be proximinal in W($\mathcal{T}$). This is obtained by the following theorem:

Theorem 1: [6]. Let B be a finite dimensional subspace of a normed linear space $\mathcal{X}$. Then u or each u ∈ X , such that ∃ an element in B of best approximation to u.

Another characterization of best approximation in W($\mathcal{T}$) is given by the following theorem .

Theorem 2 .[7]. A function h_0 in B is the best approximation to u ∈ W(T) ⇔ ∀ h ∈ B

$$\max_{t \in \mathcal{T}_0} \mathrm{Re}\left\{[u(t) - h_0(t)]\overline{h(t)}\right\} \geq 0$$

where $\mathcal{T}_0 = \mathrm{crit}(u - h_0)$.

Lemma 1. Let R = {e + λ(x − e): λ ≥ 0}. Then

$$\bigcup_{y \in R} B(y, \| y - e \|) = \mathrm{int} \cap \{\varphi^{-1}((-\infty, \varphi(e)]) : \varphi \in \mathcal{X}^*, \varphi(e - x) = \| \varphi \| \| e - x \|\} = \cap\{ \varphi^{-1}\left((-\infty, \varphi(e))\right) : \varphi \in \mathcal{X}^*, \varphi(e - x) = \| \varphi \| \| e - x \| \}.$$

Proof: Suppose B be a magnification with center s, that is,

$$B: \mathcal{X} \to \mathcal{X}$$
$$B(t) = e + \lambda(t - e), \text{ for } t \in \mathcal{X},$$

where λ > 0. B is a bijection. On the other hand, the open ball $\mathfrak{B}(x, \| x - e \|)$ and the single point set {e} are two disjoint convex sets. So there exists (by the separatior theorem, [8]) φ ∈ $\mathcal{X}^*$ such that

$$\varphi(e - x) = \| \varphi \| \| e - x \|$$

$\varphi(t) \leq \varphi(e)$, for all $t \in \mathfrak{B}(x, \| x - e \|)$.

Since $B\left(\mathfrak{B}(x, \| x - e \|)\right) = \mathfrak{B}(B(x), \| x - e \|)$ then for each $z \in \mathfrak{B}(B(x), \lambda \| x - e \|), z = M(t) = s + \lambda(t - e)$, for some $t \in \mathfrak{B}(x, \| x - e \|)$. It follows that $\varphi(z) = \varphi(e) + \lambda\varphi(t - e)(t - e) \leq \varphi(e)$. So for each y in R and $z \in \mathfrak{B}(y, \| y - e \|), z \in \varphi^{-1}\left((-\infty, \varphi(e))\right)$, for each $\varphi \in \mathcal{X}^*$ for which $\varphi(e - x) = \| \varphi \| \| e - x \|$. That is

$$\bigcup_{y \in R} \mathfrak{B}(y, \| y - e \|) \subset \mathrm{int} \cap \{ \varphi^{-1}((-\infty, \varphi(e)]) : \varphi \in \mathcal{X}^*, \varphi(e - x) = \| \varphi \| \| e - x \| \} \subset \cap\{ \varphi^{-1}\left((-\infty, \varphi(e))\right) : \varphi \in \mathcal{X}^*, \varphi(e - x) = \| \varphi \| \| e - x \| \}.$$

Now suppose that $z \notin \bigcup_y \in R\mathfrak{B}(y, \| y - e \|)$. Thus the open set $\bigcup_y \in R\mathfrak{B}(y, \| y - e \|)$ and line scgment $[z, e]$ are two disjoint convex sets and so by separation thcorem thero exists $\varphi \in \mathcal{X}^*$ that is $\varphi(e - x) = \| \varphi \| \| e - x \|$ which separate two sets $[z, e]$ and $\bigcup_{y \in R}\mathfrak{B}(y, \| y - e \|)$, i.e., $z \notin \varphi^{-1}\left((-\infty, \varphi(e))\right)$ and so

$$z \notin \cap\left\{ \varphi^{-1}\left((-\infty, \varphi(e))\right) : \varphi \in \mathcal{X}^*, \varphi(e - x) = \|\varphi\|\|e - x\| \right\} \quad \blacksquare$$

2. KOLMOGROV'S AND SUNS DESCRIPTION

Let B is a subset of $\mathcal{X}$ that is not empty and (B may not be a linear subspace of $\mathcal{X}$). If$x \in \mathcal{X} \setminus$ B and $e \in P_B(x)$, it is always true that $e \in P_B(y)$,for $y = e + \lambda(x - e)$, for all $\lambda \in [0,1]$ (since $y = \lambda x + (1 - \lambda)$ e then

$$\| x - y \| + \| y - e \| = (1 - \lambda) \| x - e \| + \lambda \| x - e \| = \| x - e \|$$

and for each $h \in$ B it follows that

$\| y - h \| \geq \| x - h \| - \| x - y \| \geq \| x - e \| - \| x - y \| = \| y - e \|$,

that is, $e \in P_B(y)$). The point e is said to be a Solar point in B for x,if $e \in P_B(y)$ for every $y = e + \lambda(x - e)$, for $\lambda \in (1, \infty)$. That is, e is a Solar point in B for x, if $e \in P_B(y)$, for every y in the half-line $R = \{e + \lambda(x - e): \lambda \geq 0\}$. A set B is said to be a sun in $\mathcal{X}$, if for each $x \in \mathcal{X} \setminus$ B,the set $P_B(x)$ contains a Solar point for x and the set R denotes a ray of the sun which passes through x. There are numerous variant concepts:

Alpha-sun, beta-sun, gamma-sun and delta -sun, meta suns and strict suns. The concept of `sun' seems to be the most important. It was formulated in the 50′s by Efimov and Stechkin [8]. It is important by the reason of results such as the following theorem.

Theorem 3: [9,10]. **(Vlasov):** If dim $\mathcal{X} < \infty$ and M is a Chebyshev subset of X then B is a sun.

A space $\mathcal{X}$ is said to be Smooth if for each $x \in E(\mathcal{X})$ (the sphere $E_{\mathcal{X}}(0,1)$ in $\mathcal{X}$) there is a unique hyperplane of support to $E(\mathcal{X})$ at x. The condition is equivalent to the condition that the norm ‖.‖ be Gateaux differentiable at each point of $\mathcal{X}\setminus\{0\}$.

Theorem 4. If X is a Smooth space and B is a sun in X then B is convex.

Proof: Suppose that $x \notin$ B, so there is a Solar point in B for x,say $e \in$ B. Ther $\mathfrak{B}(x, \| x-e \|) \cap \mathrm{B} = \emptyset$ and for each y in the half-line $R = \{e + \lambda(x-e) : \lambda \geq 0\}$, it follows that $B(y, \| y-e \|) \cap \mathrm{B} = \emptyset$. So $\left(\bigcup_{y \in R} B(y, \| y-e \|)\right) \cap \mathrm{B} = \emptyset$. Since $\mathcal{X}$ is a Smooth space then $\bigcup_{y \in R} \mathfrak{B}(\mathrm{y}, \| \mathrm{y}-\mathrm{e} \|) = H_x$ is an open half- space (by lemma 1) . So its complement is a closed half-space containing B and not x. Let $U_x = \mathcal{X} \backslash H_x$. The intersection over all $x \notin$ B of these closed half-spaces is convex and equal to B,that is , $\bigcap_x \notin \mathcal{M} F_x = \mathrm{B}$ is convex. ■

The following theorem is derived from Theorems 1 and 2 as well as Vlasov's Theorem [10].

Theorem 5: If dim $\mathrm{X} < \infty$ and X is a Smooth space then a Chebyshev subset of X is a closed convex set.

The concept of Solar point is what one needs to make sense of Kolmogorov's Characterization of best approximation.

Theorem 6. Suppose that $x \in \mathrm{X} \setminus \mathrm{B}$ and $\mathrm{h}_0 \in \mathcal{M}$. Then the following facts are equivalent:

1. $h_0 \in P_{\mathrm{B}}(x)$ and h_0 *is* a Solar point for x *in* B
2. $[h_0, h] \cap B(x, \| x-h_0 \|) = \emptyset$, for all $h \in$ B $(that\ is,\ h_0 \in P_{[h_0,h]}(x)$, for each $h \in$ B).
3. 3-For any h ∈ B,there exists $\varphi \in$ext $E(\mathrm{X}^*)$ such that $\varphi(h_0 - x) = \| h_0 - x \|$,

$$\varphi(h) \geq \varphi(h_0) ,$$

Where $E(\mathrm{X}^*)$ is the unit sphere in X^*.

4. each h ∈ B, there exists φ ∈ E(X^*) such that $\varphi(\mathrm{h}_0 - \mathrm{x}) = \| \mathrm{h}_0 - \mathrm{x} \|$, $\varphi(\mathrm{h}) \geq \varphi(\mathrm{h}_0)$.

It is worth noting that the third condition of the above theory represents the abstract form of Kol- mogorov's condition. Let $\mathcal{X} = \mathrm{W}(T)$, where T is a compact Hausdorff topological space, B is a subspace of $\mathrm{W}(\mathcal{T})$ and $f \in \mathrm{W}(\mathcal{T}) \setminus$ B,since $\mathrm{W}(\mathcal{T})^* \cong \mathcal{M}(\mathcal{T})$, the space of regular Borel measure on $\mathcal{T}$, part (3) implies that, for each $g \in$ B, there exists measure $\mu \in$ext $E(\mathrm{B}(\mathcal{T})) \cong$ext $E(\mathcal{X}^*)$ such that :

$$\begin{cases} \mu(h_0 - u) = \|h_0 - u\|, \\ \mu(h) \geq \mu(h_0). \end{cases}$$

On the other hand,

$$\begin{aligned} \text{ext } E(\mathrm{B}(\mathcal{T})) &= \{\mu \in \mathrm{B}(\mathcal{T}) : \pm\mu(\{t\}) = \| \mu \| = 1 \\ &\quad \text{for some } t \in \mathcal{T}\} = \{\mu \in \mathrm{B}(\mathcal{T}) : \\ &\quad \| \mu \| = 1 , | \text{ supp } \mu| = 1\} \\ &= \{\mu = \pm e(t) : t \in \mathcal{T} \} , \end{aligned}$$

where $e(t) = \delta_t$ is evaluation functional. This implicitly means that:

$$\varepsilon(h_0 - u)(t) = \| h_0 - u \| ,$$

$$\varepsilon(h - h_0)(t) \geq 0 ,$$

where $\varepsilon \in \{-1,1\}$. It follows that

$$|h_0(t) - u(t)| = \| h_0 - u \| ,$$

$$\big(h_0(t) - u(t)\big)\big(h(t) - h_0(t)\big) \geq 0 .$$

Thus, by the notation of Kolmogorov's theorem, $t \in \mathcal{T}_0$ and for $h_1 = h_0 - h \in$ B

$$[u(t) - h_0(t)]h_1(t) \geq 0 ,$$

That is, in the real case, $\max_{t \in T_0}[u(t) - h_0(t)]h_1(t) \geq 0$, is satisfied.

Theorem 7. Let B be a finite dimensional subspace of $\mathrm{W}(\mathcal{T})$. If $u \in \mathrm{W}(\mathcal{T}) \backslash$B and $h_0 \in$ B , then, the conditions listed in the following points are equivalent:

1. $\mathrm{h}_0 \in \mathrm{P}_{\mathrm{B}}(\mathrm{u})$,
2. Kolmogorov' s condition:

$$\max_{\mathrm{t} \in \mathrm{T}_0} \mathrm{Re}\left\{[\mathrm{u}(\mathrm{t}) - \mathrm{h}_0(\mathrm{t})]\overline{\mathrm{h}(\mathrm{t})}\right\} \geq 0 ,$$

for each h ∈ B , where $\mathcal{T}_0 = \mathrm{crit}(\mathrm{f} - \mathrm{h}_0)$,

3.The condition of the complex Characterization Theorem:

$$0 \in \mathrm{co}\left\{\left[\overline{\mathrm{u}(\mathrm{t}) - \mathrm{h}_0(\mathrm{t})}\right] \mathrm{v}(\mathrm{t}) : \mathrm{t} \in \mathrm{crit}(\mathrm{u} - \mathrm{h}_0)\right\} ,$$

4.There exists a non- empty finite subset $\mathrm{A} = \{\mathrm{t}_1, \ldots, \mathrm{t}_\tau\}$ of $\mathcal{T}$ and there is a non-zero value α(t) for t ∈ A with $\sum_{\mathrm{t} \in \mathrm{A}} |\alpha(\mathrm{t})| = 1$, such that

$$\sum_{\mathrm{t} \in \mathrm{A}} \alpha(\mathrm{t})\mathrm{v}(\mathrm{t}) = 0 ,$$

and

$$\sum_{\mathrm{t} \in \mathrm{A}} \alpha(\mathrm{t})[\mathrm{u}(\mathrm{t}) - \mathrm{h}_0(\mathrm{t})] = \|\mathrm{u} - \mathrm{h}_0\| ,$$

5.There exists a non-empty finite subset $A = \{t_1, \dots, t_r\}$ of $\mathcal{T}$ and there exists a non-zero $\alpha(t)$ for $t \in A$ with $\sum_{t\in\mathcal{A}} |\alpha(t)| = 1$ such that we obtain

$$f(t) - h_0(t) = \sigma(t) \parallel u - h_0 \parallel, \; for \; t \in A,$$

where $\sigma(t) = \operatorname{sgn} \alpha(t), for \; t \in A$.

Proof: The equivalence $(1) \Leftrightarrow (2)$ and $(a) \Leftrightarrow (c)$ are in Kolmogorov's'Characterization implies that $(1) \Leftrightarrow (5)$. We show that $(4) \Leftrightarrow (5)$. Now assume that (4) holds. The equality in above theorem implies that

$$\parallel u - h_0 \parallel = \left| \sum_{t\in A} \alpha(t)[u(t) - h_0(t)] \right| \leq \sum_{t\in A} |\alpha(t)| \; | u(t) - h_0(t) |$$

Thus

$$\sum_{t\in A} | \alpha(t)[u(t) - h_0(t)]| = \parallel u - h_0 \parallel = \sum_{t\in A} \alpha(t)[u(t) - h_0(t)],$$

and so $\alpha(t)[u(t) - h_0(t)] \geq 0$, for $t \in A$. On the other hand, $|\alpha(t)| > 0$, $\sum_t \in A|\alpha(t)| = 1$ and

$$|u(t) - h_0(t)| \leq \parallel u - h_0 \parallel \quad , \quad for \quad t \in A .$$

It follows that $|u(t) - h_0(t)| = \parallel u - h_0 \parallel$, for all $t \in A$, that is, $A \subset \operatorname{crit}(u - h_0)$.

since u not in B then $u(t) - h_0(t) \neq 0$, for $t \in A$. So $\alpha(t) \neq 0$, for $t \in A$ implies that $\alpha(t)[u(t) - h_0(t)] \neq 0$, for all $\in A$. Therefore,

$$\alpha(t)[u(t) - h_0(t)] > 0 \quad , \quad \text{for all} \quad t \in A,$$

that is, $\sigma(t) = \operatorname{sgn} \alpha(t) = \operatorname{sgn} [u(t) - h_0(t)]$, for all t in A . Since $A \subset \operatorname{crit}(u - h_0)$ then $u(t) - h_0(t) = \sigma(t)\|u - h_0\|$, for $t \in A$. Thus $(4) \rightarrow (5)$. Also, obviously $(5) \rightarrow (4)$. ■

Remark 1. In Theorem 7. (4), (5), $1 \leq r \leq n + 1$ In the actual instance and $1 \leq r \leq 2n + 1$ in the complex case and the set A is a basic set for B and u.

Theorem 8: If r is the smallest integer such that part (4) of Theorem 7 is satisfied then for each $j = 1, \dots, r$ the functional $v(t_1), \dots, \widehat{v(t_j)}, \dots, v(t_r)$ are linearly independent.

Proof: Let there exists $j, 1 \leq j \leq r$ such that the functionals

$$v(t_1), \dots, \widehat{v(t_j)}, \dots, v(t_r),$$

are linearly dependent. So $v(t_k) \in \operatorname{sp}\{v(t_i): 1 \leq i \leq r, i \neq j, k\}$ for some $k \neq j$ $v(t_j) \in \operatorname{sp}\{v(t_i): i \neq j, 1 \leq i \leq r\}$ then $(t_j), v(t_k) \in \sup\{ v(t_i): i \neq j , k , 1 \leq i \leq r \}$, that is, $\dim(\operatorname{sp}\{ v(t_i) : 1 \leq i \leq r \}) \leq r - 2$.

Therefore $\dim(\mathrm{B}|_A) \leq r - 2$ *since* ($\sup\{v(t_i): 1 \leq i \leq r\} = (\mathrm{B}|_A)^*$ and $\dim \mathrm{B}^* = \dim \mathrm{B}$). Let $h_0 \in P_{\mathrm{B}}(u)$. It follows that $0 \in \operatorname{co}\{(u(t) - h_0(t))v(t): t \in A\}$. Now by implication $(1) \rightarrow (4)$ in Theorem 7, applied to $\mathrm{B}|_A \subseteq C(A), u|_A$ and $h_0|A$, there exists a subset $A' \subseteq A$ with card $A' \leq \dim \mathrm{B}|_A + 1 \leq r - 1$ and there exist non-zero $\alpha'(t)$ for each $t \in A'$ with $\sum_{t\in A'} |\alpha'(t)| = 1$, such that

$$\sum_{t\in A'} \alpha'(t) \, v(t) = 0 .$$

But by our hypothesis r is the smallest integer such that $\sum_{t\in A} \alpha(t)v(t) = 0$ is satisfied. Which is a contradiction. This completes the proof. ■

Remark 2. In the proof of above Lemma, we claimed that sp $e(\mathcal{T}) = \mathrm{B}^*$. If it is not, then sp $e(\mathcal{T}) \subsetneq \mathrm{B}^*$.Then there exists $\varphi \in \mathrm{B}^* \backslash \{0\}$ such that $\varphi(\operatorname{sp} v(\mathcal{T})) = \{0\}$. But $\varphi = h$ for some $h \in \mathrm{B}$ and $v(T)(h) = \{0\}$, that is, $h(\mathcal{T}) = \{0\}$, which is a contradiction. Finally, future research may focus on translating these findings into real-world scenarios, such as mathematical optimization as in [10].

3. CONCLUSIONS

According to Kolmogorov's theorem, the best approximation in a real standard linear space X is described. Furthermore, the concepts of proximal set, smooth space, sun, sun point, and their relationship with the Kolmogorov condition are discussed. The effectiveness of using the best approximation in situations where high accuracy in calculating standard linear spaces is required is revealed.

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Arabic Abstract

إن التقريب الأمثل للمجموعات الفرعية للدوال داخل الفضاءات القياسية يسهل نمذجة البيانات وإدارة الأنظمة الخطية وغير الخطية. في هذه البحث، يتم وصف أفضل تقريب في فضاء خطي قياس حقيقي X بواسطة نظرية كولموغوروف. بالإضافة إلى ذلك، تتم مناقشة مفاهيم المجموعة القريبة، والفضاء السلس، والشمس، ونقطة الشمس، وعلاقتها بشرط كولموغوروف. أخيرًا، تم تسليط الضوء على فعالية استخدام أفضل تقريب في المواقف العملية لتحقيق دقة عالية في حساب الفضاءات الخطية القياسية.

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