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Green synthesis of nano binary oxide SiO_2/V_2O_5 NPs integrated ointment cream application on wound dressings and skin cancer cells

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Abstract

Green synthesis is depending on preparation of nano composited SiO_2/V_2O_5 by using the modified sol-gel method depending on rice husk ash as a source for the extraction of silica gel and the product powder of nano composited SiO_2/V_2O_5 characterization by many techniques such as X-ray diffraction spectroscopy (XRD), field emission scanning electron microscopy (FESEM), and N_2 adsorptions/desorption isotherms (BET). This study also includs the biological effectiveness of SiO_2/V_2O_5 and its effect on inhibiting bacterial growth after the prepared nanomaterial was applied to wound dressings, which gave a promising result for its use as topical dressings that remove microbes especially for burns and wounds patients, due to its high effectiveness in killing Gram-positive bacteria S.aurea positive bacteria at a concentration of 625 µg/mL, which is characterized by its resistance to many antibiotics. Antibiotic resistance is one of the problems that many researchers seek to solve this problem by providing more effective and safe antibiotics. Choosing silica extracted from a natural substance to reduce the toxicity resulting from the use of chemicals, as silica oxide is considered a non-toxic substance. Therefore, during preparation, care was taken to use chemicals in low concentrations to reduce toxicity. In vitro cytotoxic effects were studied of composited SiO_2/V_2O_5 nanoparticles on Vero cell line 101 and skin cell line-A431were investigated at different concentrations. MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay was used to determine the cytotoxic effects of green synthesized nanopowders.

Keywords: Antibiotic, Green Synthesis, Nano composited, Rice husk, Skin cancer, toxicity.

Introduction

Artificial nanoparticles (NP) synthesis is limited due to high prices, energy consumption, and the additional resources that are required to dispose of harmful by-products. As a result, non-polluting, low-cost, and renewable energy sources such as rice husk ash concede perfect materials and non-toxic can be used to extract silica nanoparticles[1,2]. Nanotechnology has represented a branch of science that is related to the study of matter at the nanoscale, with dimensions ranging from 1 to 100 nm[3,4].
Nanotechnology represents an advance in the medical field with the ability to deliver drugs to specific cells using nanoparticles[5]. The total consumption of the drug in addition to the side effects can be significantly reduced by providing the necessary dose to cover a long period without any other doses [6]. Some of the important applications in the field include treating cancer using iron nanoparticles or gold shields and several other diseases [7]. The use of natural raw materials instead of chemicals that are more toxic and expensive this method reduces the cost and side effects [8]. Rice husk ash raw materials contain many chemical compounds such as silica 96.15%, alumina 0.48% and ferric oxide 0.156% [9]. Rice straw has many applications, including energy, and raw material [10]. Therefore, it is interesting to study. Nanotechnology can improve energy consumption efficiency and help to decrease environmental pollution[11]. It has greatly increased production rates with reduced costs, solves significant health issues and is interesting in medical fields. Nanoparticles can be used to transmit drugs, light, heat, or other materials to specific cells such as cancer cells. Also, nanomaterials have interacted with diseased cells or some materials such as SiO_2, ZnO, and V_2O_5. which can be used as an

antimicrobial against many different microorganisms [12,13].

Several studies were interesting in the preparation and characterization of heterogeneous catalysis of nanoparticles, based on metal and mixed metal oxides. A few reports on V_2O_5/SiO_2 mixed oxide[14]. Silica oxide catalysis has many applications such as commonly used as a rubber and plastic additive, as a reinforcing filler for concrete and other building composites, and as a safe, non-toxic platform for biomedical applications such as drug delivery[15]. F. Farzaneh et al a one-pot sol-gel approach was used to make V_2O_5/SiO_2 nanoparticles from vanadyl-acetylacetonate and tetraethylorthosilicate in refluxing MeOH, followed by calcination at 700 °C for 2 hours [16]. Green chemistry is the creation of chemical products and processes that minimize or eliminate the use of hazardous substances [17-19]. Green synthesis is a new field of bio-nanotechnology that offers economic and environmental advantages over traditional chemical and physical methods [20]. Nanomaterials produced using a green synthesis method have a lot of potential for industrial use. Since it is less expensive, safer, and pollutes the atmosphere less than other methods [21-25]. For the processing of Nanomaterials, conditions such as acidity, reactant concentration, and mixing temperature may be regulated [26,27]. Tumour cells may be treated with various metal oxide nanoparticles, and notably, V_2O_5 nanoparticles have an outstanding potential due to vanadium's strong cytotoxicity and antitumor effects [28]. Katayoon Kalantari et al, the development of new wound dressing materials that do not rely on antibiotics is critical. Incorporating nanoparticles into scaffolds currently represent– a new concept of 'nanoparticle dressing,' which has gained significant interest for wound healing. Silver Nanoparticles (Ag-NPs) are metal-based nanoparticles that are intriguing materials for wound healing because of their outstanding antimicrobial properties Wound healing is aided by Ag-NPs embedded in wound dressing polymers and regulates microorganism growth However, there have been several recent drawbacks to using Ag-NP in combat. Infections, such as bacterial resistance. This review focuses on the therapeutic approaches to wound dressings Ag-NPs and their potential roles in revolutionizing wound healing were functionalized. Furthermore, the physiology of skin and wounds are discussed to determine where the use of Ag-NPs in wound care into perspective[29]. The main aim of the present work is to synthesise, characterized and investigate biological activity for composite SiO_2/V_2O_5 nanoparticles as a reagent for medical skin treatments.

Metrial and methods

Rice husk from locally agricultural, Hydrochloric acid is from British Drug purity 98.5%, Sodium Hydroxide is about Reagent World purity 97%, triple distilled water. Sulphuric acid is from British Drug House purity 99.5% and vanadium (V_2O_5) oxide Chem. Pure 99.8 % BATCH No.170159, Miller Hinton agar powder(HIMEDIA M173-500G) , Nutrient Broth(M002-100G) and solvent Dimethyl Sulfoxide(DMSO). The fresh skin cancer cell line A431and Vero cell line-101 were procured from the National Institute of Genetic Engineering and Biotechnology in Tehran, Iran, with permission from the Ethical Committee of the Pharmaceutical Sciences Branch of the Islamic Azad University of Tehran.

Synthesis of nanocomposites by using a modified sol-gel method that involves three steps. The first step of preparation for silica gel by extracting SiO_2 from Rice Husk Ash(RHA). By taking 10 g of burning rice husk ash, then adding 80 mL of sodium hydroxide solution 2.5 N concentration with a magnetic stirrer. Under 100 ˚C for 4 hours dissolve the silica existing in rice husks ash by using a 250 Erlenmeyer flask. The product is filtered and washed with warm distilled water. In this step, the final transparent viscous and colourless product, which is a sodium silicate as the following reaction:

$SiO_2\,(RHA) + NaOH \rightarrow Na_2SiO_3 + H_2O$……..1

Using titration method for extraction of pure silicon dioxide by preparation 5N of sulfuric acid solution H_2SO_4 and gradually added to a sodium silicate solution with a magnetic stirrer under 100-90 ˚Ctemperature in this step complete precipitation of silica and form sodium sulphate such as the following reaction:

$Na_2SiO_3 + H_2SO_4 \rightarrow SiO_2 + Na_2SO_4 + H_2O$…….2

The gel product was washed for longing time with warm distilled water to remove sodium sulphate impurities as shown in Fig. 1. The second step of preparation included solution by adding 15 mL of deionized water, 35 mL ethanol and 7 ml ammonia into 250 mL of Erlenmeyer flasks with stirring at room temperature. The third step involves dissolving Vanadium pentoxide V_2O_5 in 15 mL of deionized water and mixed with the silica gel that was prepared in step one and added to the solution that was prepared in the second step. Ultrasonic treatment for 15 minutes and the colloidal dispersion is stirred for 12 hours. Nanocomposite product is separated by centrifuge and is washed with deionized water three times. The product is dried in an oven at 60˚C. Nanoparticles of SiO_2/V_2O_5 were characterized by X-ray diffraction, FESEM, and BET techniques.

Figure 1. Preparation steps of silica gel from RHA. A. Rice husk, B. Rice husk ash at 700 ˚C treatment, C. silica gel, and D. Nano binary oxide SiO_2/ V_2O_5 powder.

Antibiotic activity assays require the preparation of solutions. These solutions were prepared by dissolving 38 g of miller Hinton agar powder in 1000 mL of triple distilled water, sterilizing the solution for 30 minutes at 121 ˚C, cooling the solution to 37 ˚C, and then pouring the solution into sterilized Petri dishes with an inoculum. It is prepared by culturing gram-positive bacteria (S.aureas) in sterile saline solution to a concentration of 0.5 McFarland (1.2*108 CFU/ml). Microbial colonies (S.aureas) were isolated and identified from the wound and burn patients utilizing biochemical testing [30]. The nanocomposites SiO_2/V_2O_5 powder was made at concentrations of (control = 0, 625, 312.5, and 31.25)g/ml, the nanocomposites SiO_2/V_2O_5 dissolved in DMSO solvent, and their antibacterial activity was determined. After coating wound dressings with nanocomposites SiO_2/V_2O_5, Petri dishes were incubated at 37 ˚C for 24 hours.

Vitro Method to Measure Cytotoxicity of Nano binary oxide SiO_2/ V_2O_5

Synthesis of nano binary oxide SiO_2/ V_2O_5 nanoparticles and studying the effect of these nanoparticles with different concentrations (2000,1000,500,250,125, 62,31,15.5and 7.5) µg/mL where sterile test tubes were prepared, where take1 mL of the complete medium 200µL from the stock solutions for nano binary oxide SiO_2/ V_2O_5, with a concentration of 20000µg/mL. First tube the concentration of it 2000 µg/mL, then it made a series of dilutions to prepare the following concentrations (2000,1000,500,250,125 , 62,31,15.5and 7.5) µg/mL. After the preparation of the concentrations is completed, 200 µL are taken from each concentration and added to the skin cancer cells were seeded into a 96-well cell culture microtiter plate. Each concentration was replicated with four as a control group for each cell type. Then the plate was covered with a self-plastic lid and incubated at 37 ˚C for 24 hours, at the end of the exposure period, the cell lines growth was assessed by cytotoxicity assay by MTT assay After 24 hours, we are doing an MTT test. After the incubation period, add 200 µL of the MTT labelling reagent to each well, and incubate the 96-well cell culture microtiter plate for 4 hours in a humidified environment, such as 37°C, 5–6.5% CO_2. Add 100 µL of the Solubilization buffer into each well. Allow the plate to stand overnight in the incubator in a humidified atmosphere, such as 37°C, with 5 to 6.5% CO_2. The optical density (OD value) of each well is determined using a microplate (ELISA) reader at once, using a microplate reader set the wavelength at 570 nm. The user should open the micro-plate reader in advance, preheat the instrument, and set the testing parameters[31].

Study the activity of medical ointment on S.aureas

Composition of medical ointments from the prepared active ingredient and applying them to medical gauze the method of work includes several steps preparation of an ointment base, which consists of two phases, the first is an oil phase including emulsifier material and the second is an aqueous phase. The oil phase includes weight of 12.5 g of beeswax white and 70 mL paraffin oil, and it is placed in a ceramic jar inside a water bath at 60˚C, then added the mineral oil (paraffin) and mix well. An aqueous phase preparation by weight of 1g of borax and 1g of water dissolves the borax into the water in a water bath at 60 °C (both liquid phase and oil phase at the same temperature). After completing the melting process for the oil phase the water phase is gradually added to the oil phase with continuous stirring, and then a preservative is added, which is Benzoic acid (0.1%) [32]. After preparation ointment base takes 1g from emulsions and mixes with different weights of (0.04, 0.06, 0. 08 and 0.1) gram nano active powder SiO_2/V_2O_5. Each weight of nano active powder is mixed well to ensure the homogeneity of the active substance with the emulsion (ointment base) to obtain an effective medicinal ointment

Results and discussion

Nanocomposites SiO_2/V_2O_5 powder result is characterized by X-ray diffraction (2700 AB HAO YUAN) technique, Cu Kα (λ = 1.54 A°). Fig. 2. Explain comparison between the x-ray pattern of vanadium pentoxide V_2O_5 pattern and nanocomposites SiO_2/V_2O_5 whereas occurrence new peaks with high intensity in pattern nanocomposites SiO_2/V_2O_5 powder at 2ᵒ, 18.290,23.812 and 28.406 such as shown in Table1, shift other peaks when compared to vanadium pentoxide V_2O_5 pattern. The crystal size of nanocomposites SiO_2/V_2O_5 powder was calculated from the Deby-Scherrer equation as shown in equation 3.

$L = k\lambda/\beta Cos\theta$ …..3

L= thickness of crystallite (mean crystal size), K= Scherrer s constant depends on crystal shape(0.94 is spherical,0.90 tubes or rode and 0.89 or 0.85 wire or other shapes), λ= is the wavelength (0.1540 nm), β= FWHM * Π/180,andᵒ = is Bragg angle

Table 1.The crystal size of nanocomposites SiO_2/V_2O_5 powder.

No	2ᵒ[Th]	Crystal size nm
1	15.2739	42.450
2	18.2904	36.779
3	21.6912	37.019
4	23.8126	27.193
5	28.4068	47.623
6	30.9426	43.421
7	33.2276	43.622
8	34.3261	43.724
9	35.9159	17.551

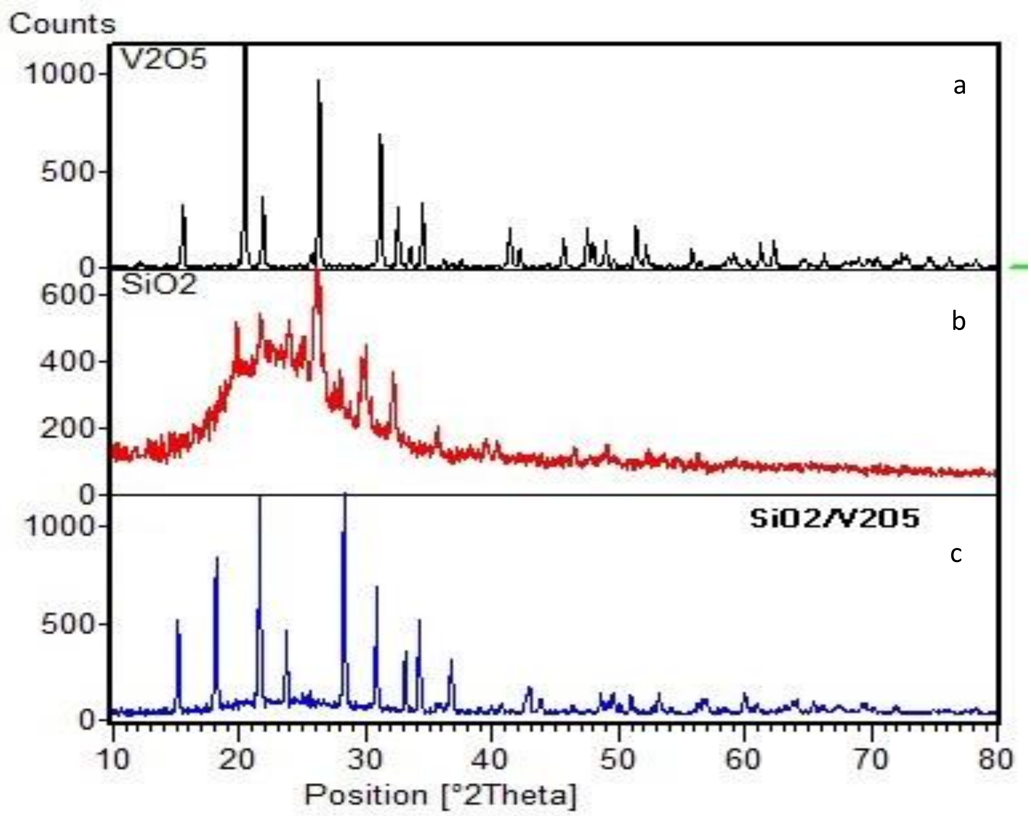

Figure 2. X-ray diffraction patterns, a. Vanadium pentoxide V_2O_5, b. silica oxide and c. nanocomposites SiO_2/V_2O_5.

The EDX values for nanocomposites SiO_2/V_2O_5 investigated are quite near to those expected theoretically, indicating the presence of information of concentration on specific elements found in a sample such as shown in Table 2 and Fig.3. The scanning micrographs were obtained using a model (MAG 400 Kx Germany) attached to the EDX unit. FESEM has the ability to examine morphology of surface well-matched with EDX . Advantage of FESEM is that high resolution imaging can be performed. The scanning electron microscopy (FESEM) imaging technique allows for the visualization of very small features with dimensions of several nanometers. It employs a focused beam of electrons to scan the sample's surface. Secondary electrons are produced when the electron beam interacts with the sample, providing information on the surface topography. Backscattered electrons are sometimes used to determine differences in sample composition. FESEM of the image shows the structural morphology of nanocomposites SiO_2/V_2O_5 heterogeneous the spherical partials refer to silica partials overlapped with the crystal lattice of vanadium oxide with diameter partical size (31.53) nm as shown in Fig.4.

Table 2. The percentage weight of elements for nanocomposites SiO_2/V_2O_5 powder.

Element	Intensity	Weight %
C	194.7	22.44
O	328.2	27.91
Na	44.0	1.52
Si	1429.3	25.66
F	15.2	1.20
S	513.1	7.86
V	411.4	13.41

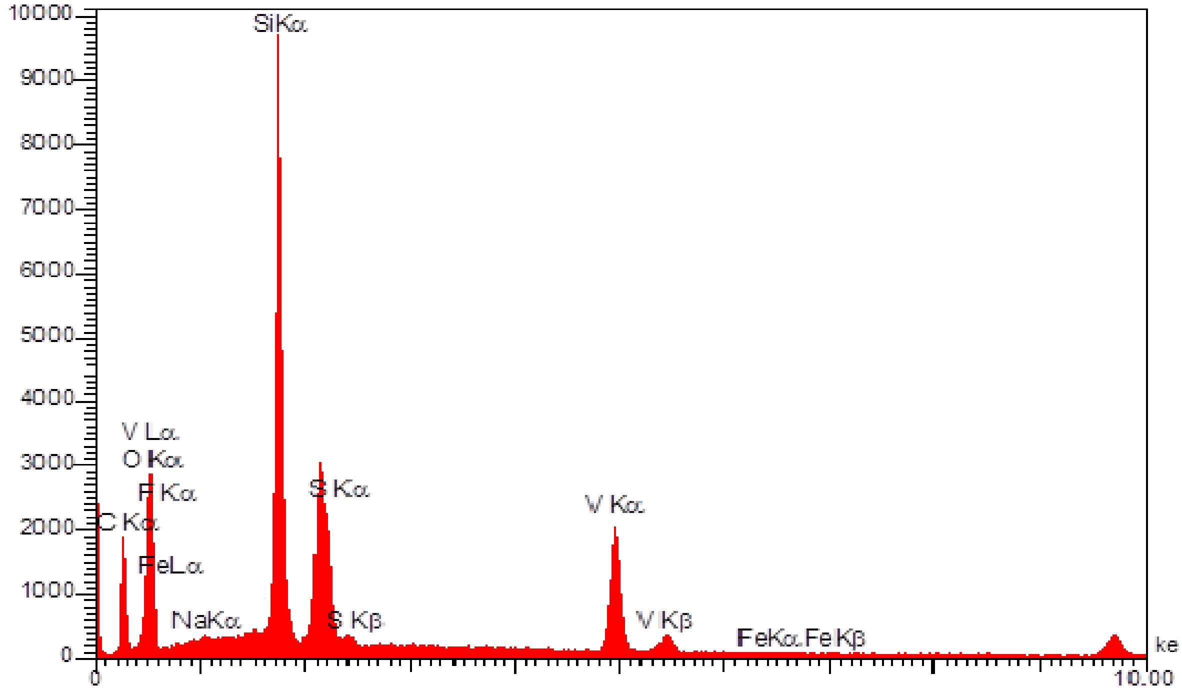

Figure 3. EDX of nano binary oxide SiO_2/V_2O_5 powder.

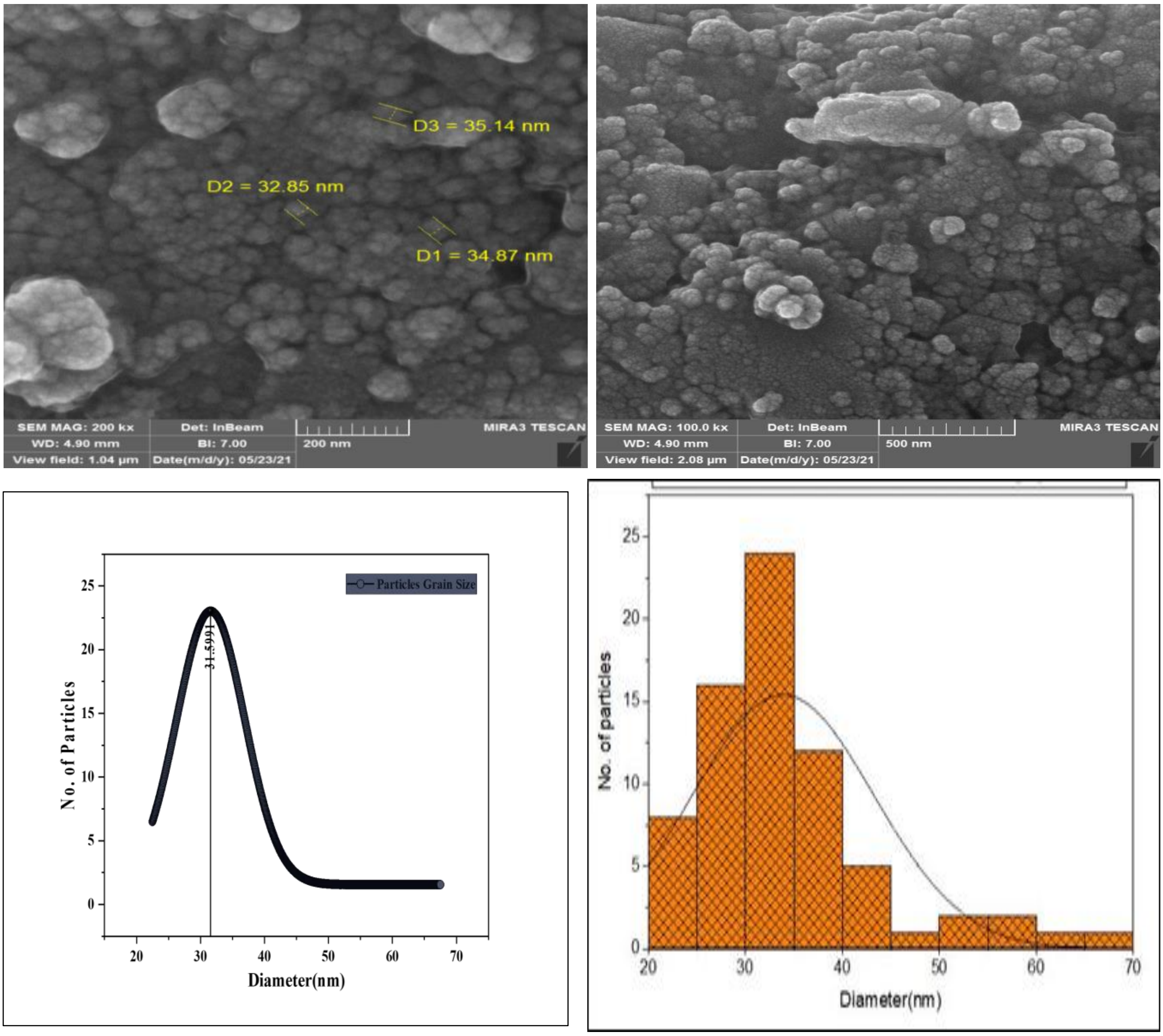

Figure 4. FESEM images of nano binary oxide SiO_2/V_2O_5 and distribution of particle sizes.

Typically, BET measurements are used to establish a link between the particle size and the surface area. Additionally, this metric helps us to categorize the pore size, much as the shape of the adsorption isotherm does. The porous structure of the materials, which may be micro, meso, or macroporous, is demonstrated by BJH the average crystal size (32.412-47.0187) nm for nanocomposites SiO_2/V_2O_5 and silica oxide respectively such as shown in Table 3 . We note from the specific surface area (SBET) values for silica oxide powder that extraction from rice husk ash occurs smaller than nanocomposites SiO_2/V_2O_5 such as shown in Table 3 and Fig.5.

Table 3. Surface area and average size crystal of the silica oxide and nanocomposites SiO_2/V_2O_5.

Antibiotic	SBET (m^2 /g)	Average size crystal (nm)	Average Pore diameter(nm)
SiO_2	95.143	47.018	9.1831
SiO_2/V_2O_5	187.541	32.412	7.9098

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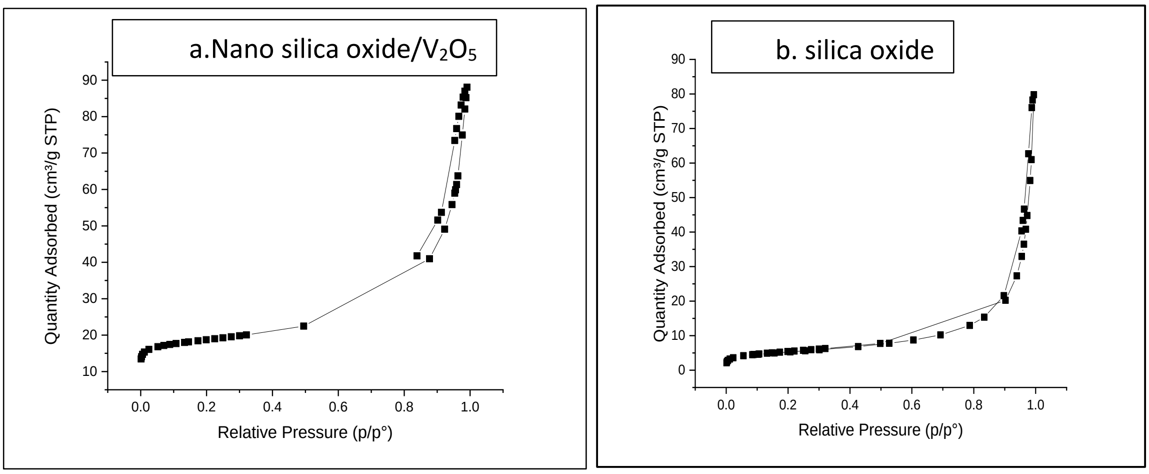

Figure 5. Nitrogen adsorption isotherms for a. nano-silica oxide/V_2O_5 and b. silica oxide.

Nano binary oxide SiO_2/V_2O_5 can be disrupted the bacterial cell by releasing Si^{+4}, V^{+5} and O^{-2} ions which have interaction with bacterial membranes, this type of interaction involves generation ROS [33]. Antibiotics' widespread usage in the prevention and treatment of bacterial infections has resulted in the emergence and spread of the spread of resistant germs necessitates the development of novel antibacterial compounds, nano composited silica oxide/V_2O_5 has promising activity against g-positive bacterial S.aurea, the solution applied with different concentrations on wound dressing after sterilization it such as shown in table 4 and Fig.6.

Table 4. The effect of dose of nanocomposites SiO_2/V_2O_5 that applied on wound dresses on the growth microbial (S.aurea).

Concentration /µg/ml	Zone inhibition/mm
625 (H.D)	27
312.5 (M.D)	25
31.25 (L.D)	20

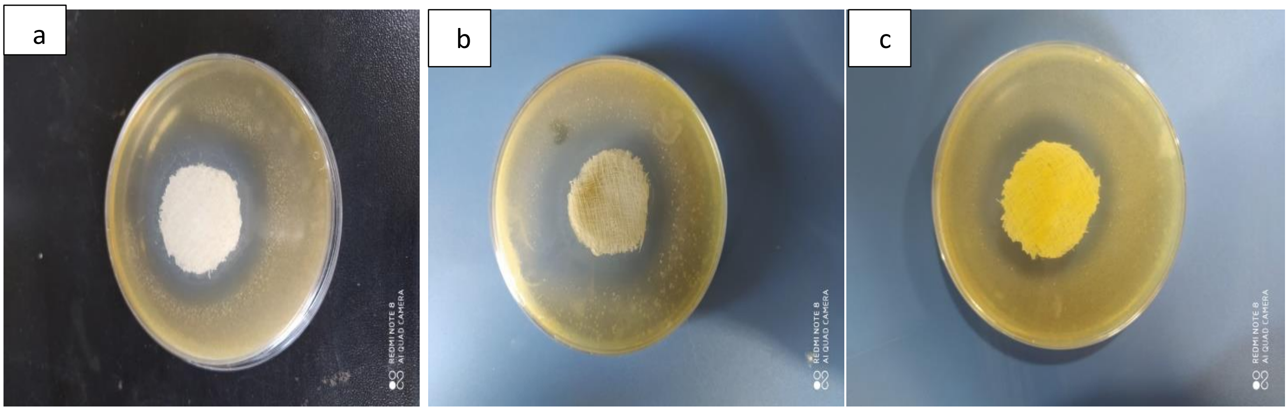

Figure 6. Show zone inhibition for silica oxide /V_2O_5 with various doses a. High dose,b. Medium dose, and c. Low dose.

Cytotoxicity evaluation of Nano binary oxide (SiO_2/ V_2O_5,) nanoparticles agents skin cancer-A431cells and Vero cells-101.

Nano binary oxide silica oxide/V_2O_5 shows promising selectivity against skin cancer line A431cells, this is due to ROS that could be produced by the addition of hazardous nano binary oxide silica oxide/V_2O_5 nanoparticles with crystal size 32.412 nm. Alternatively, aside from the generation of ROS, another mechanism could be involved in nano binary oxide silica oxide/V_2O_5 cytotoxicity. It's well known that vanadium compounds inhibit a variety of enzymes specifically, protein tyrosine phosphatases (PTP). PTP allows glucose uptake into cells to be stimulated (insulin-mimetic action) A high concentration of glucose within the cells should affect cellular metabolism. The previous study found the accumulation of lactate in the cell could have resulted in a decrease in cellular pH and an increase in the cytotoxicity of nanoparticles V_2O_5 to FsaR and L929 cells furthermore, because of the high cytotoxicity. The effect observed on FsaR cells suggested that nanosize V_2O_5 was used in particles in the environment that could be considered poisonous FsaR fibrosarcoma cell therapy. Nano cytotoxicity agents like nano V_2O_5 are characterized by the ability to treat cancerous tumours by stimulating the production of ROS, and higher levels of antioxidative enzymes in tumour cells that work on ingestion ROS[34]. In this work we used nano binary oxide silica oxide /V_2O_5 that prepared by using rice husk as raw material instead of chemicals to study cytotoxicity on skin cancer line A431cells and Vero cells-101line, the result shows the half-maximal inhibitory concentration values for its IC50 was 411.246 µg/mL and 792.660 µg/mL for skin cancer line A431cells and Vero cells-101line respectively such as shown in Fig. 7 that make it has selective cytotoxicity. At a high concentration of 2000 µg/mL no selective toxicity was observed on skin cancer line A431cells and Vero cells-101line such as shown in table 5 and Fig. 8 that show affect the viability of cells at concentrations (2000,1000, 500, 250, 125, 62,31.5 and 7.5) µg/mL of nano binary silica oxide /V_2O_5. We demonstrated in this study that nano binary oxide silica oxide /V_2O_5 NPs could give a new route for alternative therapeutic treatment options for anti-bacterial and anti-cancer.

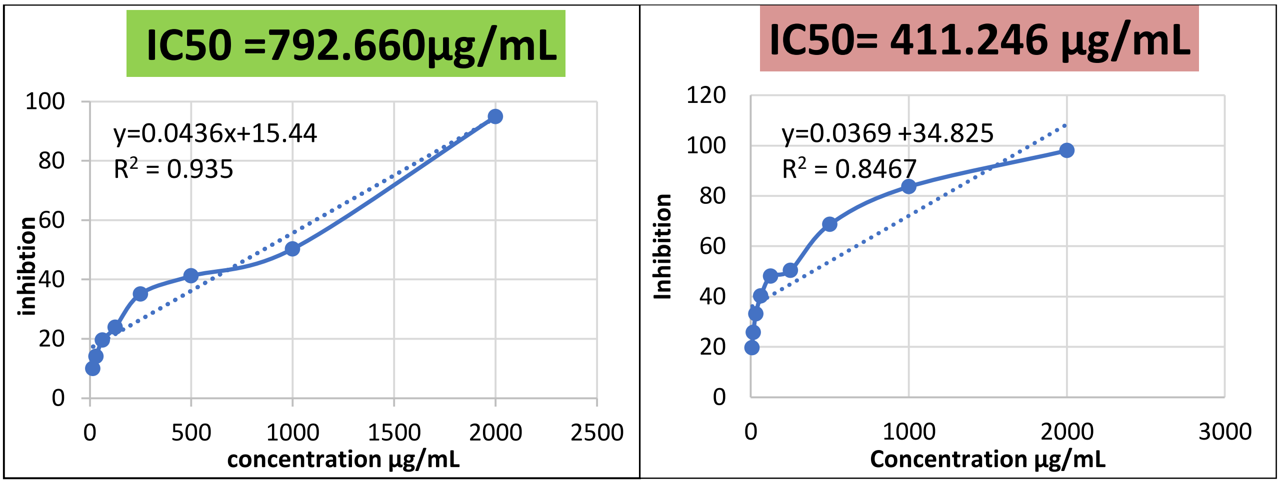

Figure 7. IC50 measurements of nano binary silica oxide/V_2O_5 on skin cancer line A431cells (right) and Vero cells-101line (left).

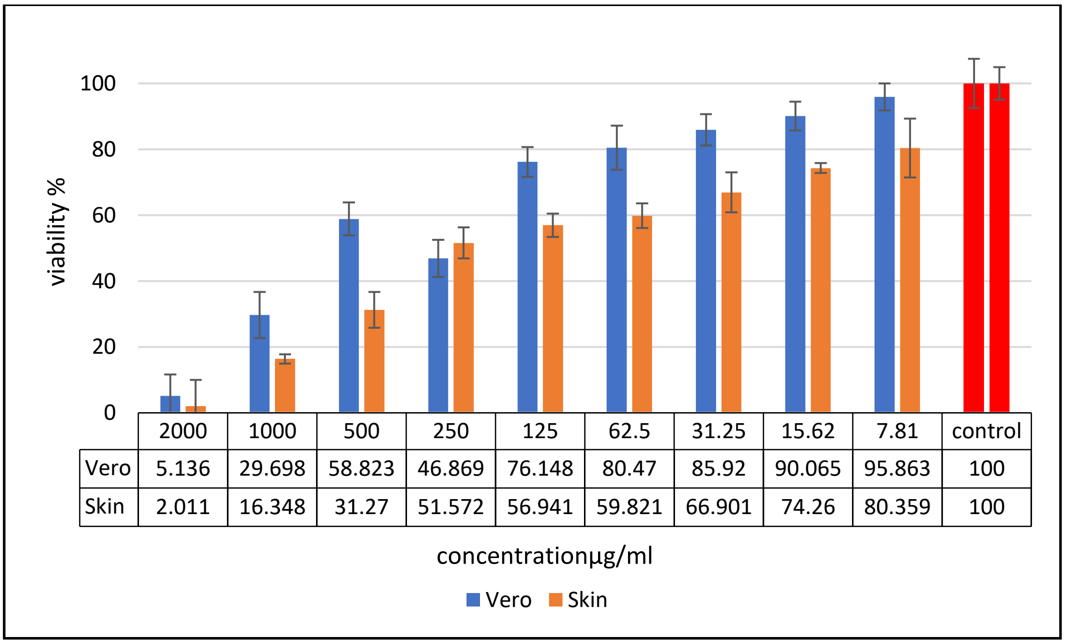

Figure 8. Effects of nano binary oxide silica oxide/V_2O_5 on the viability of skin cancer A431 cells line and Vero cells-101 cells line using MTT assay.

Table 5. Cytotoxicity effect of nano binary silica oxide /V_2O_5 NPs on skin cancer A431 line cells and Vero cells-101 line and data are presented as mean ± SD of four independent experiments.

Vero cells-101 line			Skin cancer cells -A431line			
Inhibition	Stander devigen %SD	Average %	Inhibition	Stander devigen %SD	Average %	Concentration SiO_2/V_2O_5
94.864	4.081	5.136	97.989	7.943	2.011	2000
50.302	4.347	49.698	83.652	1.377693	16.348	1000
41.177	4.743	58.823	68.73	5.453719	31.27	500
35.131	6.724	46.869	50.428	4.728916	49.572	250
23.852	4.510	76.148	48.059	3.549312	51.941	125
19.530	5.644	80.470	40.179	3.764986	59.821	62
14.086	5.020	85.920	33.099	6.062897	66.901	31
9.935	7.041	90.065	25.74	1.496108	74.26	15.5
4.137	4.731	95.863	19.641	8.954	80.359	7.5
-	6.459	100	-	4.939	100	Control

Study the activity of medical ointment on S.aureas

The antibacterial activity of nano binary oxide silica oxide/V_2O_5 nanoparticlies as medical ointment was evaluated. This study was against Gram-positive bacteria S.aureas. The results of the assay show the diameter of the inhibition zones increased with increasing nano ointment dose. The percentage weight study range from (4-to 10)% as shown in Table 6. Metal nano binary oxide because of its small size and applicability, nanoparticles have prompted a lot of interest. Playing a role in providing a healthy environment, and assist in wound healing by inhibiting microbial growth [35]. The results of medical ointment for nano binary oxide silica oxide/V_2O_5 NPs that show 10% give high zone inhibition as shown in Fig.9. So the nano ointment can be used for antimicrobial and wound healing. Especially since the nano binary oxide silica oxide/V_2O_5 NPs showed a low toxicity assay. Nano binary oxide SiO_2/V_2O_5 has emerged as a novel agent for the treatment of bacterial work as antibacterial activity against drug-resistant bacteria including methicillin-resistant Staphylococcus aureus (MRSA). In this study, we developed an ointment composed for the treatment of MRSA-infected cutaneous wounds.

Figure 9. Medical ointment cream preparation from nano binary silica oxide/V_2O_5 NPs (right) and image of zone inhibition of ointment cream(left).

Table 6.The activity of nano binary oxide (silica oxide/V_2O_5) ointment with different percentage weights.

Wight%	Zone inhibition /mm
10%	19
8%	12
6%	9
4%	7

Conclusions

Rice husk ash natural raw can be used to obtain pure silica gel through the green synthesis route, after treatment with different conditions such as strong acids and heat. The modifying sol-gel method gives pure silica gel composite with vanadium pentoxide. Nano binary oxide SiO_2/V_2O_5 is characterized by X-ray diffraction. The average particles size (31nm) depended on the SEM image. FESEM make clear morphology of the surface and distribution of particles size in nanoscale for nanocomposites SiO_2/V_2O_5. Nano composited has promising antibiotic activity against bacterial S.aureas that gives high zone inhibition at a concentration of 625 µg/mL. Nano binary oxide SiO_2/V_2O_5which showed highly efficient results and a promising effect for the production of topical medical preparations with therapeutic efficacy by studying the effect of these ointments on the bacteria of burns and wounds. This study was observed, as this nanoparticle was able to kill cancer cells with very low concentrations when compared with normal cells, and this makes it characterized by selectivity and efficiency to be used as a medicinal drug to treat cancer cells without showing high toxicity towards Vero cell line (normal cells) as shown by the results. The study also included the preparation of medical ointments from prepared nanomaterials SiO_2/V_2O_5 which showed highly efficient results and a promising effect for the production of topical medical preparations with therapeutic efficacy by studying the effect of these ointments on the bacteria (S.aureas) .Which are located on the surface of the skin exposed to burns or wounds, which cause a delay in healing.

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Authors' declaration:

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are mine ours. Besides, the Figures and images, which are not mine ours, have been given the permission for re-publication attached with the manuscript.
- Ethical Clearance: Ethics approval and consent to participate Ethics Committee (University of Babylon/ College of Science/ Iraq), Ref. no.: 4122 .Date: 27/9/ 2021. The current study was conducted in accordance declaration of Helsinki depended when dealing with human samples.

Authors' contributions statement:

Abbas A-A Drea suggest search plan and helped with data analysis, Marwa Ali working on the developing the idea of search , analyzed parameters ,preparation the method work to reach the appropriate condition, wrote the manuscript. All authors discussed the results and contributed to the final manuscript.

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التوليف الأخضر للأوكسيد الثنائي SiO_2 /V_2O_5 جسيمات متناهية الصغر تطبيق كريم مرهم متكامل على ضمادات الجروح وخلايا سرطان الجلد

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الخلاصة:
اشتملت الدراسة الحالية على تحضير المزدوج النانو SiO_2/V_2O_5 باستخدام مواد طبيعية خام كمادة أولية حيث استخدمت رماد قشور الارز بعد حرقها بدرجة 700˚C سيليزية للتخلص من المواد العضوية واللاعضوية في القشور حيث كانت هي المادة الخام لاستخلاص السليكا جل والتي تم مزجها مع أوكسيد الفناديوم الخماسي وتم تشخيص المزدوج النانو SiO_2/V_2O_5 المحضر باستخدام عدة تقنيات مثل الأشعة السينية ,المجهر الالكتروني الماسح عالي الدقة حيث تم حساب معدل الحجم الحبيبي باستخدام صورة المجهر الالكتروني الماسح للسطح المادة المحضرة عند المقياس 200 نانومتر , مطيافية تشتت الطاقة بالأشعة السينية التي استخدمت لكشف تركيز العناصر الموجودة في النموذج المحضر SiO_2/V_2O_5 من مادة قشور الارز الخام وتقديرها كميا ونوعيا وكذلك تم قياس المساحة السطحية للسليكا المستخلص والمزدوج المحضر SiO_2/V_2O_5 والمقارنة بينهما كما موضح في النتائج كما تضمنت الدراسة البحثية الفعالية البيولوجية للمزدوج SiO_2/V_2O_5 وتأثيرها على تثبيط النمو البكتيري بعد أن تم تطبيق المادة النانوية المحضرة على ضمادات الجروح حيث أعطت نتيجة واعدة لاستخدامها كضمادات موضعية تعمل على إزالة الميكروبات وخاصة لمرضى الحروق والجروح وذلك بسبب فعاليتها العالية لقتل البكتيريا الموجبة S.aurea عند تركيز 625 µg/mL التي تتميز بمقاومتها للعديد من المضادات الحيوية . تعتبر مقاومة المضادات الحيوية من المشكلات التي يسعى العديد من الباحثين لحل هذه المشكلة من خلال توفير مضادات حيوية أكثر فعالية وأمانًا. اختيار مادة السيليكا المستخلصة من مادة طبيعية لتقليل السمية الناتجة عن استخدام الكيماويات ، حيث تعتبرالسيليكا مادة غير سامة. لذلك ، أثناء التحضير ، تم الحرص على استخدام المواد الكيميائية بتراكيز منخفضة لتقليل السمية. تم دراسة التأثيرات السامة للخلايا في المختبر NPs(SiO_2 / V_2O_5) على خط الخلايا الطبيعية Vero 101 وخط خلايا الجلد A431 وتم فحصهما بتراكيز مختلفة. تم استخدام 4) -3) MTT، -2 (5-dimethylthiazol-2-yl)، 5-diphenyltetrazolium bromide) لتحديد التأثيرات السامة للخلايا للمساحيق النانوية الخضراء المُصنّعة.

الكلمات المفتاحية : مضاد حيوي ،التوليف الاخضر, مركب نانو، قشور الأرز ، سرطان الجلد, السمية.