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# The effect of different structural compositions to improve the functional properties of fabrics producing eye pads by using zinc oxide nanoparticles

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**Abstract**
Nanotechnology is one of the modern technologies and has many applications that include the manufacture of particles or particles in the nanoscale. The word nano has emerged from the Greek word Nano, meaning dwarf, and nanoparticles are defined as single particles whose dimensions do not exceed 100 nanometers. There are many possibilities for applications Nanotechnology in the field of cotton and other textile industries, and the current research aims to improve the functional performance of cotton fabrics producing eye bandages that require attention to catch up with progress in the field of nanotechnology, As well as designing medical textiles and raising the efficiency of performance until it reaches the quality stage that achieves high competition.
Cotton fibers are characterized by natural properties due to their resistance to bacterial activity, but they are affected by contamination with microorganisms. Therefore, researchers in this field must come up with satisfactory solutions to address this problem, by conducting extensive research using various types of nano-oxides within this field. The best example is nano-zinc oxide in concentrations different.
In this research, 100% cotton fabric was used, and it was treated with nanometric zinc oxide with different concentrations, which will be mentioned later in the practical part. The research aims to study the effect of the chemical treatment used on the resistance of cotton fabrics to bacteria and fungi, as well as the mechanical properties (cutting strength and elongation) of the treated bandage.

**Keywords:** Dressings - starch - zinc nitrate - sodium hydroxide

## Introduction
Nanotechnology is one of the modern technologies that have many applications in the manufacture of particles or particles in the range of the nanoscale. The use of nanotechnology has increased in the textile industry to become multifunctional and characteristics and produce fabrics with specific specifications in protection from bacteria and ultraviolet radiation, ease of cleaning and repelling stains and anti-odor [2]. Many studies have been concerned with the application of nanotechnology in the field of clothing and textiles by using various nanomaterials, including silver oxide nanoparticles (AgNPs), where it was used to improve clothes [3]. To treat weft knitted fabrics to improve the functional performance of underwear for athletes. Titanium dioxide (TiO2) was also used as a catalyst to improve the resistance of fabrics to wrinkle and sun protection [4], The importance of zinc oxide nanoparticles (ZnO NPs) has increased in the medical field and has been used in many pharmaceutical preparations [5], Zinc oxide is characterized by characteristics such as (light weight _ high strength _ small size _ high stability) as well as excellent chemical reaction, which qualifies it in the fields of research and development for all disciplines mainly [6, 7].

## The aim of the research
Using zinc oxide nanoparticles in various concentrations to enhance the functional performance of medical fabrics while researching how these produced oxides affect the fabrics' mechanical qualities (cutting strength and elongation - mass per square meter) and resistance to germs and fungi. The objective of this study is to make eye bandages' physical characteristics better so they can perform their intended function. through its resistance to the pathogenic germs that infect the injured area of the skin, as demonstrated later in the biological examination, as well as by not attaching the bandage to the skin's surface in order to spare the patient any pain.

## Experimental

### 1. Chemical treatment

The chemical treatment solution is made by combining 0.75 grams of starch with 100 milliliters of distilled water. Following thorough dissolving, distinct weights (0.75%, 1.00%, 1.2%gm) of the colorless crystals known as zinc nitrate are added. In a glass beaker with a capacity of 200 ml, the pigment is thoroughly mixed after being fully liquefied, and then a few drops of sodium hydroxide (0.01 M) are added. After 25 minutes, we observe the emergence of a zinc hydroxide emulsion. It is well known that starch acts as a stabilizing agent and holding agent for zinc oxide. After the mixing is finished, the solution is kept at room temperature for 12 hours while being constantly stirred by an [8].

$$Zn(NO_3)_2 + NaOH \longrightarrow Zn(OH)_2$$

### The immersion process

The medical dressing that needs to be treated is submerged for 10 minutes in a beaker filled with various concentrations of zinc oxide solution. The dressing cloth is squeezed using a machine or any other method that works, after which it is dried for 5 minutes at 80 °C before being roasted for 2 minutes at 110 °C. As H2O builds up, zinc oxide nanoparticles develop on the ocular pads' surface.

Zinc oxide nanoparticles that have been dissolved in starch particles have been obtained [9].

### Preparation of zinc oxide

Zinc oxide nanoparticles (ZnO NPs) can be made in a variety of ways, including physically and chemically. These are our summaries:

- Thermal fumigation
- Chemical vapor deposition
- Physical vapor deposition
- Sol-gel method
- Electrochemical deposition

The precipitation method is one of the most straightforward and affordable ways to prepare drops of sodium hydroxide into a solution of zinc sulfate or any other salt containing zinc until the PH is reached. After that, the washing process is carried out, the precipitate is filtered several times, and it is then dried to produce a white precipitate of zinc oxide [10].

### FTIR Spectrometers

The raw material and other additives to the active substance were diagnosed in this study [11], and then the fixing material for zinc oxide nanoparticles was diagnosed, which is a polysaccharide known as starch, which acts as a catalyst and a mask for the oxide on the surface of medical ophthalmic dressings, infrared spectrum The red one gives an idea of the structure of matter, where the molecule is in a state of vibration and the bonds are stretched, contracted and bent relative to each other.

We note from the three forms ((1-2-3, respectively, the frequency of the alcoholic OH peak)) because it is related to the aliphatic methyl group cm-1 (3355-3350-3457) and differs from the phenolic (OH) because it is linked to an aryl group, the frequency of the CH group confined between cm-1 (2120-2867,) as well as the group CH2)) 1638-1637-1645) cm-1), then we notice a group (c-o) within frequencies, respectively, within the figures cm-1 (1152-1144-1187) then (CH out of – plane hand) is cm-1 (950-998). These frequencies that were mentioned are for the active groups of the stabilizer.

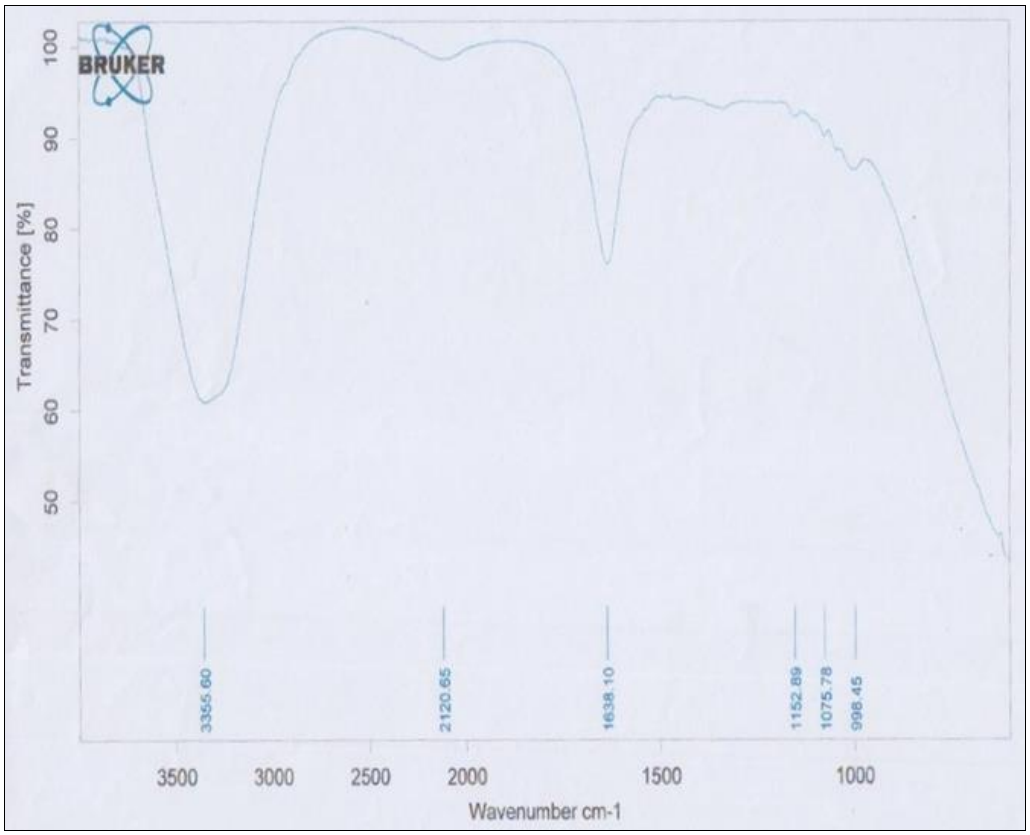


**Fig 1:** FT-IR spectrum

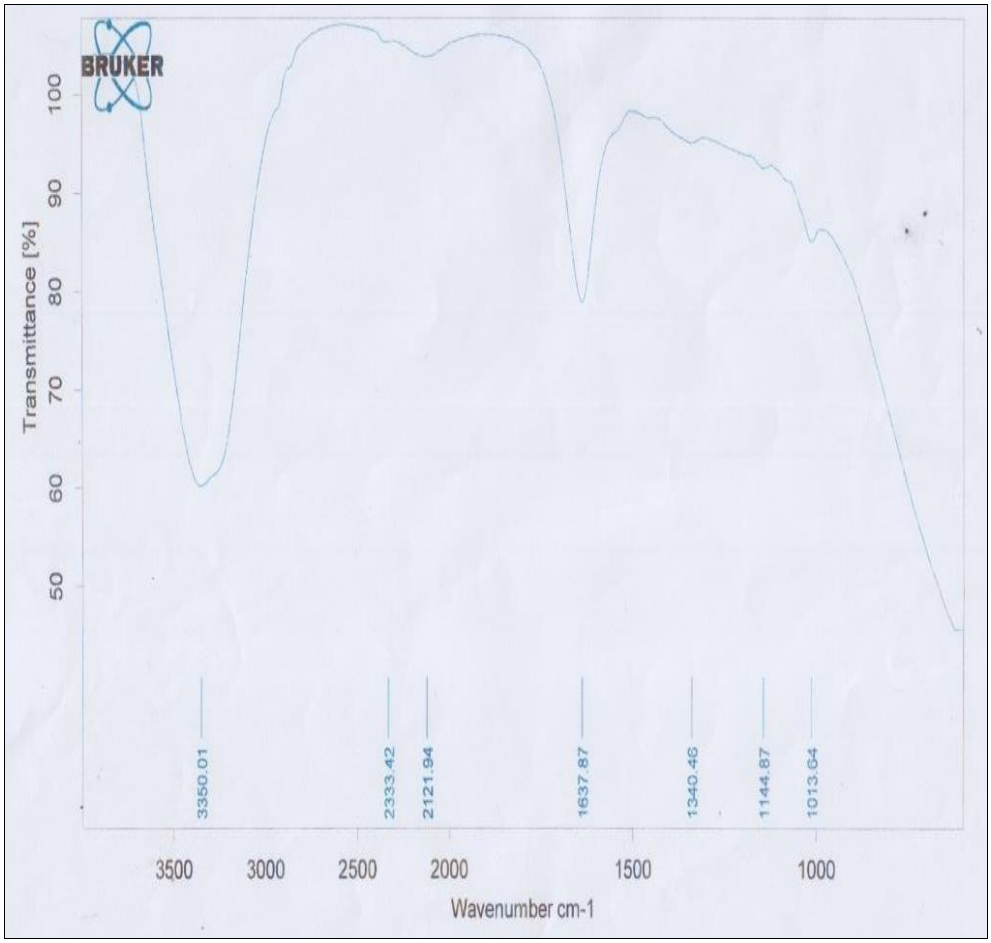


**Fig 2:** FT-IR spectrum

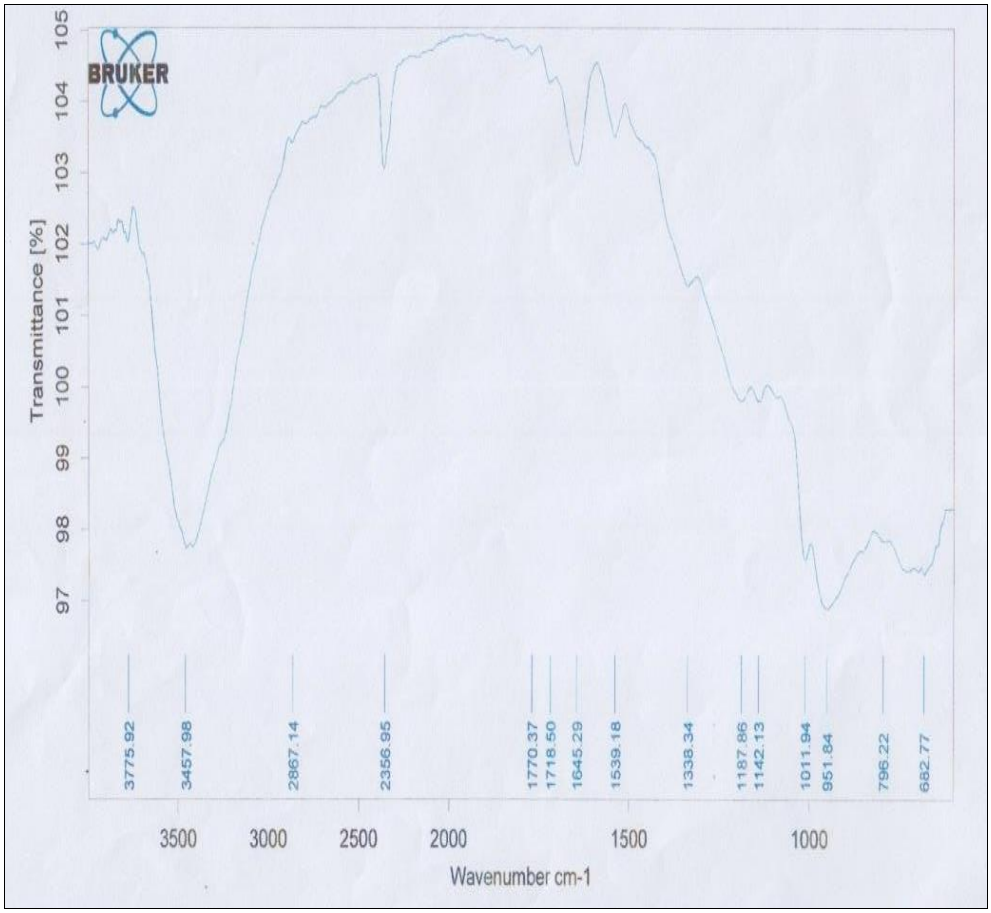


**Fig 3:** FT-IR spectrum

**Particle Size**

Comparing the sizes of liquid (drops), solid (spots), and gaseous particles all fall under the concept of particle size (bubbles). Both colloidal particles and environmental particles are subject to the particle size. Ultrasound, light, an electric field, gravity, or centrifugation [12]. After determining the zinc oxide's refractive index (2.0041), verifying the correct dissolving, and taking samples, the solutions were made with various quantities of zinc oxide dissolved in starch particles. The samples were then placed in a capacitance tube. After shaking the tube several times before to the examination to guarantee the proper solubility of the solution, (5ml) for each sample and delivered to the examining party, the test is performed in the (Particle Size) device until we get a good reading in the range. As shown in Figure (4-5) and Table (1-2).

**Table 1:** The granular size of zinc oxide

| D (nm) | G (d) | C (d) |
|---|---|---|
| 5.62e-1 | 0.00 | 0.00 |
| 1.00e+0 | 0.00 | 0.00 |
| 1.78e+0 | 0.00 | 0.00 |
| 3.16+0 | 100.00 | 100.00 |
| 5.62e+0 | 0.00 | 100.00 |
| 1.00e+1 | 0.00 | 100.00 |
| 1.78e+1 | 0.00 | 100.00 |
| 3.16e+1 | 0.00 | 100.00 |
| 5.62e+1 | 0.00 | 100.00 |
| 1.00e+2 | 0.00 | 100.00 |
| 1.78e+3 | 0.00 | 100.00 |
| 3.16e+3 | 0.00 | 100.00 |
| 5.62e+3 | 0.00 | 100.00 |
| 1.00e+4 | 0.00 | 100.00 |
| 1.78e+4 | 0.00 | 100.00 |

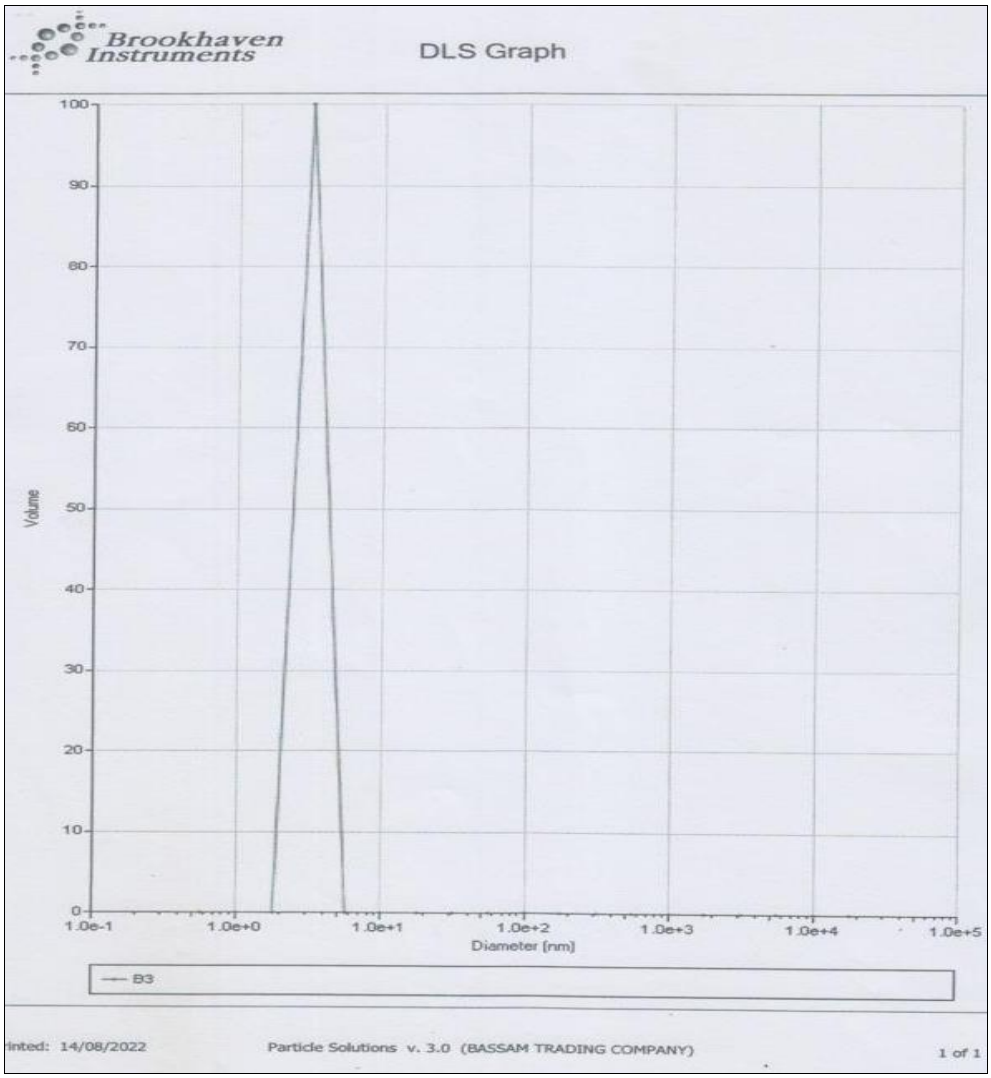


**Fig 4:** For the best particle size of zinc oxide

**Table 2:** Particle size of zinc oxide

| D (nm) | G (d) | C (d) |
|---|---|---|
| 1.98e+1 | 0.00 | 0.00 |
| 2.86e+1 | 0.00 | 0.00 |
| 4.13e+1 | 0.00 | 0.00 |
| 5.95e+1 | 100.00 | 100.00 |
| 8.58e+1 | 0.00 | 100.00 |
| 1.24e+2 | 0.00 | 100.00 |
| 1.78e+2 | 0.00 | 100.00 |
| 2.57ee2 | 0.00 | 100.00 |
| 3.71e+2 | 0.00 | 100.00 |
| 5.35e+2 | 0.00 | 100.00 |
| 7.71e+2 | 0.00 | 100.00 |
| 1.11e+3 | 0.00 | 100.00 |
| 1.60e+3 | 0.00 | 100.00 |
| 2.31e+3 | 0.00 | 100.00 |
| 3.34e+3 | 0.00 | 100.00 |
| 4.81e+3 | 100.00 | 100.00 |
| 6.93e+3 | 100.00 | 100.00 |
| 1.00e+4 | 100.00 | 100.00 |
| 1.44e+4 | 100.00 | 100.00 |

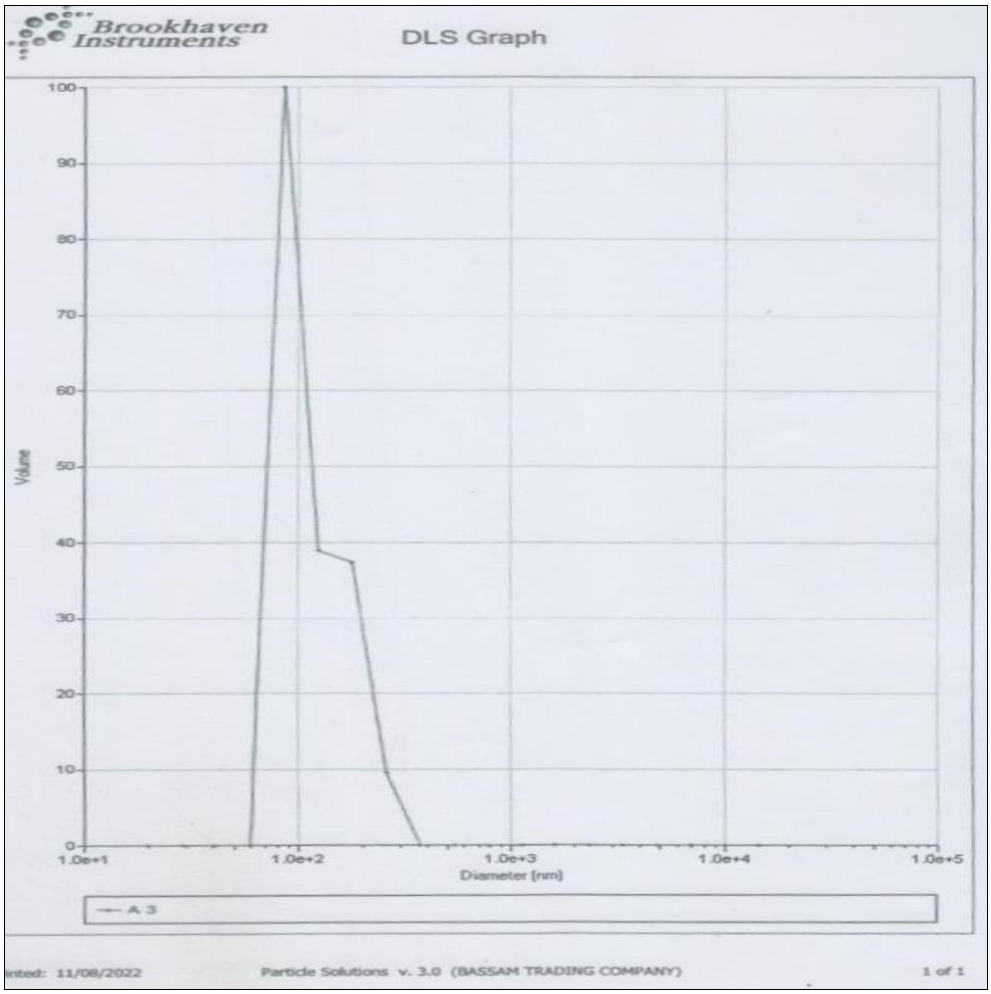


**Fig 5:** The granular size of zinc oxide

**Mass per square metre**

This test is indicated by a difference in the weight of the medical dressing before and after treatment with zinc oxide nanoparticles. The sample is submerged in a beaker of zinc oxide solution at various concentrations for 30 minutes until the medical dressing absorbs the solution, after which it is dried in an oven at 110 degrees Celsius. Once the samples have cooled, they are weighed before and after the treatment [13]. As shown in Table (3) below.

**Table 3:** Shows the results of square meter mass

| No | before the transaction | After the transaction | Notes |
|---|---|---|---|
| | 0.925g | 1.13g | Size 3 cm×3 cm |
| | 1.03g | 1.24g | Size 3 cm×3 cm |
| | 1.08g | 1.31g | Size 3 cm×3 cm |

**Microbiological examination**

The science of microbiology focuses on the study of microorganisms, such as bacteria, fungi, and viruses, which can be either unicellular or multicellular, as well as eukaryotes (viruses), prokaryotes, like fungi, and prokaryotes, like bacteria [14].

The goal of this research is to create a medical dressing for the eyes made of a substance that is effective in inhibiting the growth of pathogenic microorganisms (bacteria and fungi), including Staphylococcus aureus. This substance is zinc oxide nanoparticles (ZnO NPs).

Escherichia coli, Pseudomonas, and Candida, protecting burns and wounds against adverse effects and infections brought on by these microorganisms [15]. The statistical findings for the efficacy of each concentration are shown in Table (5), and it turns out that the models prior to treatment were (Zero), while the first

**Table 4:** Shows the results of the biological examination

| Sample | *E. Coli* ATCC 10536 | St. aureuse ATCC 6538 | Pseudomonas ATCC 15442 | Candida Albieans ATCC 10231 |
|---|---|---|---|---|
| zero | _No found | No found | No found | No found |
| 1 | No found | 22 | 21 | 22.5 |
| 2 | No found | 24 | 21 | 23.5 |
| 3 | 23 | 24 | 22 | 25 |

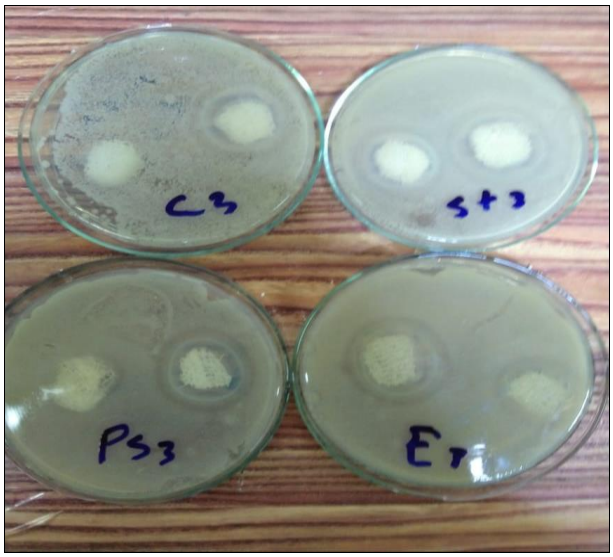


**Fig 6:** Shows the biological examination

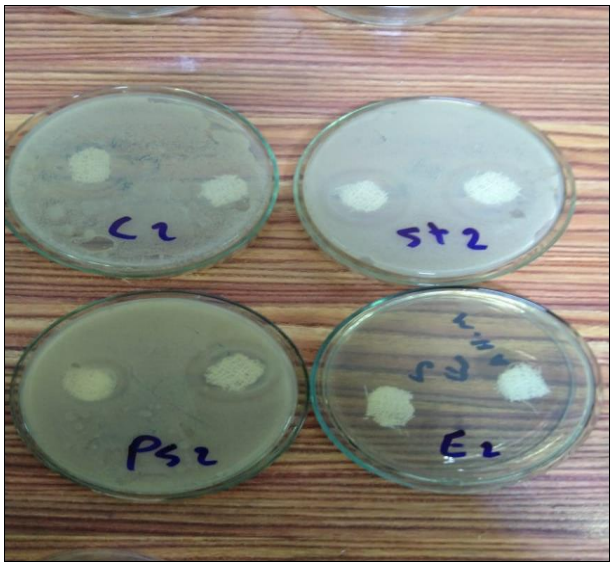


**Fig 7:** Shows the biological examination


**Fig 8:** Shows the biological examination

## Results and Discussion

The process of deposition of zinc oxide nanoparticles dissolved in starch particles, which is considered a binder and stabilizer for the oxide (ZnO NPs) on the medical dressing. Its biological effectiveness through the results, and we note the different concentrations proved biological effectiveness (0.75gm%), 1.00gm, 1.2gm), but there is a difference in the concentrations of the ratios as shown in figures (7-8-9), Including Staphylococcus aureus, *Escherichia coil*, *Pseudomonas*, *Candida*, thus preserving scratches from infections and side complications caused by these microorganisms, as well as preventing oxide contamination by seizing foreign bodies away from the place of the eye, and also one of the conditions that must be met in the ideal dressing is to provide the surface of the eyes with the necessary moisture The ease of removal and the speed of recovery. Other tests such as (mass per square meter - cutting force and elongation) have proven a difference in weight and mechanical strength as shown in Tables (3) (4). As for the FTIR examination, it has shown the effective totals of the fixative (starch) as shown in the figures (1-2-3), as well as the granular size analysis of zinc oxide that was examined in the filling center, which showed the best results, as shown in Table (1-2) and Figures (4-5).

## Conclusions

The tests conducted in the specialized centers have proven that the use of nanoparticles of zinc oxide in an emulsified form in the treatment of (eye) bandages acts as a protective shield to protect against bacteria and fungi. The third concentration is the best (1.2 gm) %. As for the dressings before the treatment, it was found to be ineffective.

## Recommendations

Extending research on chemical or physical treatments for medical fabrics in order to develop new standards for capturing regional markets and establishing competition in the market. Scientific research must be utilized and connected in spinning and weaving mills for application and product development.

Resuming nanotechnology and textile engineering studies that were discontinued in Iraqi universities.

Creating educational workshops and programs for students both before and after they enroll in college so they can learn about nanotechnology applications.

## References

1. Patra JK, Gouda S. Application of nanotechnology in textile engineering: An overview. Journal of Engineering and Technology Research. 2013;5(5):104-11. Research Journal - Mansoura University - Issue 44 - October 2016.
2. Patra JK, Gouda S. Application of nanotechnology in textile engineering: An overview. Journal of Engineering and Technology Research. 2013;5(5):104-11.
3. EL-Ashmawy SA. A nanotechnology approach to improve the functional performance of athlete's underwear. International Design Journal. 20161;6(2):163-72.
4. M Sami S, Barakat O. Use of nanotechnology to achieve the best functional characteristics of the fabrics sheets used in hospitals. Egyptian Journal of Chemistry. 2018;61(4):705-15.
5. Kadhim MA, Salman HE, Hana'a A. Adsorption of Albumin and Creatinine on Zinc Oxide (ZnO) Nanoparticles.
6. Paul DR, Robeson LM. Polymer nanotechnology: nanocomposites. Polymer. 2008;49(15):3187-204.
7. Al-Kifaie AM, Al-Noamany AH, Ali BH, Abojassim AA. Preparation And Study of The Properties of Nano Structured Zinc Oxide Prepared by The Hydrothermal Method. Journal of algebraic statistics. 2022;13(2):1609-12.
8. Vigneshwaran N, Kumar S, Kathe AA, Varadarajan PV, Prasad V. Functional finishing of cotton fabrics using zinc oxide–soluble starch nanocomposites. Nanotechnology. 2006;17(20):5087.
9. 9-Teterycz H, Suchorska-Woźniak P, Fiedot M, Karbownik I. Deposition of zinc oxide on the materials used in medicine. Preliminary results. Fibres & Textiles in Eastern Europe. 2014;3(105)):126-32.
10. Mistry BD. A handbook of spectroscopic data-chemistry (UV, IR, PRM, 13CNMR and Mass Spectroscopy). Jaipur, India; c2009.
11. Wang S, Hou W, Wei L, Jia H, Liu X, Xu B. Antibacterial activity of nano-SiO2 antibacterial agent grafted on wool surface. Surface and Coatings Technology. 2007;202(3):460-5.
12. Gatou MA, Lagopati N, Vagena IA, Gazouli M, Pavlatou EA. ZnO Nanoparticles from Different

Precursors and Their Photocatalytic Potential for Biomedical Use. Nanomaterials. 2023;13(1):122.
13. 11-Theophile T, editor. Infrared spectroscopy: Materials science, engineering and technology. BoD–Books on Demand; c2012.
14. Lyklema H. Preface to Volume II: Solid-Liquid Interfaces. In Fundamentals of interface and colloid science. 1995;2:7-9. Academic Press.
15. Boeker E, Van Grondelle R. Environmental physics: sustainable energy and climate change. John Wiley & Sons; c2011.
16. Singh B, Satyanarayana T. Basic microbiology. InCurrent Developments in Biotechnology and Bioengineering; c2017. p. 1-31. Elsevier.
17. Duran N, Marcarto PD. D&# 8217; Souza GIH, Alves OL, Esposito E. Antibacterial effect of silver nanoparticles produced by fungal process on textile fabrics and their effluent treatment. J Biomed Nanotechnol. 2007;3:203-8.