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Antibacterial Textile's Surface via Bio-molecule Encapsulated Silver Nanoparticles.

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ABSTRACT

Introduction: The new sources of antibiotics or antibacterial substance are green synthesized encapsulated (Bio-molecules/Ag) nanoparticles (NPs) .In this research I have investigated Artocarpus heterophyllus leaf extracts of bio-molecules encapsulated AgNPs against bacterial contamination on wool fiber surfaces. AgNPs synthesized by using AgNO3 solution, lab grade reagents and Artocarpus heterophyllus leaf extracted bio-molecules etc.

Objectives: My main aim of this study is to achieve a smart way for the synthesis of bio-molecules capped magnetic Ag NPs by utilizing Artocarpus heterophyllus leaf extract and evaluatuation their antibacterial properties and feasibility against both Gram-positive and Gram-negative bacteria after assemble synthesized AgNPs on the surfaces of textiles substance.

Materials & methodology: In this study we have functionalized Rayon viscose fabric surfaces by synthesized AgNPs after enhancing fabric surface adsorption properties (chemically surface modification). Then characterizations of the synthesized Ag NPs and surfaces properties of fabric have done by various techniques which are given in the experimental parts brifely.

Result: Finally, evaluated results of antibacterial activity against Gram-positive bacteria & Gram-negative bacteria (to GB/T 20944.3-2008 (eq. ISO 20743-2007) showing that nanoparticles are active against both gram positive and gram negative bacteria on the fiber surfaces. So, results suggest that encapsulated AgNPs are active as an antibiotic on the surfaces and various inhabitation zones are found also. Inhabitation zone depend on nanoparticles concentration.

Conclusion: Artocarpus heterophyllus leaf extracted bio-molecules encapsulated Ag NPs potential antibacterial which may very encouraging substance for application in the field of wearable anti-hygienic or medical textiles purposes.

KeyWords: Artocarpus heterophyllus leaf, Bio-molecules, Ag-Nano particles, Regenerated viscose fabric, Surface Modification, Wet chemistry, Bacterial contamination, Medical textiles.

1.introduction:

An extremely important part of Bangladesh economy is textile [1].The dramatic increase in the popularity of knitted fabrics during the last three decades provides a vivid example of the interrelationships between lifestyle, technology and fashion[2] and the GDP share of RMG of Bangladesh was 14.07% in 2013-14 [3, 4]. Not only the textile industry plays a vital role to augment the socio-economic development of Bangladesh but also pose major public health problem[5] also. Surface smoothness is one of the important qualities and requirements imposed by the consumer. As clothing remains next to human skin it is very sensitive issue to ensure this quality properly [6], because Bacterial contamination is one of the drawbacks from TEXTILE materials [7].The large area of textile is conducive also to microorganisms' growth, such as fungi and bacteria, which can be found almost everywhere and are able to quickly multiply, depending on the moisture, nutrients and temperature levels and one single bacteria cell can increase to 1,048,576 cells in just 7 h, finally causes a range of undesirable effects on the textile itself but also on the user. These effects include the generation of unpleasant odor, reduction in mechanical strength, stains and discoloration and an increased likelihood of user contamination. Therefore, due to the growing public health awareness of the pathogenic effects, over the last few years, intensive research and development have been promoted in order to minimize or even eliminate microbe's growth on textiles. This microbial contamination is a great concern, mainly for textiles used in hospitals as medical devices or for health and hygienic care, but also in sports clothing, water purification systems, animal feed and the food industry. The infections acquired in hospitals may be caused by several species, such as Escherichia coli, Klebsiellapneumonia, Pseudomonasaeruginosa and Acinetobacterbaumannii.Therefore,consumers are becoming increasingly aware of the implications on personal hygiene and the health risks associated with some microorganisms, the demand for antimicrobial textiles has presented a big increase over the last few years [8-13].The usual chemical synthesis susceptible microorganisms in the human body are becoming resistant to the available chemical antibiotics, which is a serious public health concern [14].For this reason encapsulated NPs will apply from synthesized Artocarpus heterophyllus trees leaf, its commonly known as jackfruit, a famous fruit variety in Bangladesh, is an angiosperm, belonging to the Moraceae family which is widely cultivated and grows in the tropical region of the world.[15] and its leaf extract consists of several biomolecules, such as sapogenins, cycloartenone, cycloartenol, bsitosterol, and tannins[16]. On the other hand, due to unique properties of Ag NPs against microorganisms, they are in high demand in consumer products such as medicine and medicinal devices, foodstuffs, cleaning agents, and clothing[17-20].
My main aim of this study is to achieve a smart way for the synthesis of bio-molecules capped magnetic Ag NPs by utilizing Artocarpus heterophyllus leaf extract and to evaluate their antibacterial properties , feasibility against both Gram-positive and Gram-negative bacteria after assemble synthesized AgNPs on the surfaces of textiles substance i.e. regenerated rayon viscose fabric by chemical wet processes.

2. Experiment:

2.1Materilas and methods:
Materials that have been used to this works some are: Viscose fabric, wool fabric, AgNO3, Detergents, reagents, water etc.

2.1.1: Synthesis of silver nanoparticles:
AgNO3, Green leafs/leaf powder; water and lab grade reagent etc. materials have been used to Synthesis of silver nanoparticles (Ag NPs) with several steps to synthesis of silver nanoparticles. 1st of all fresh green leafs have been collected then made those leafs into powder by blender machine. 5kg Powder +100ml water solution heated by 80c at 10min, collected leaf extract by filtering. AgNO3 solution have been dissolved into water (1:4 ratio) heated by 60c temperature at 10min and finally found AgNPs after washing and dried.

2.1.2: Sample preparation (Regenerated rayon viscose fabric):
2.1.2:Dust/Dirt removal process.
Fabric no need to scouring or bleaching because it has no any grey or yellow color by born. I have collected viscose fabric then washed 20min at normal temperature (60c) to remove dust dirt from fabric surfaces then dried 45c temperature.
2.1.3: Surface modification by wet chemical process
Finally, I have prepared samples by enhancing adsorption properties producing negatively charge Carboxyl group onto viscose fabric. Finally, with or without oxidization viscose fabric was dissolve into the leaf molecules solution of 0.5% to attached or coated with encapsulated green bio molecules/AgNPs on surface of viscose fabric.

2.1.4: Characterization of the synthesized silver nanoparticles (Ag NPs):
To ensure functional groups & evaluate thermal stability in the Artocarpus heterophyllus leaf extract in the expected Ag NPs, Fourier transform infrared (FT-IR), Thermo gravimetric analysis (TGA) was carried out.

2.1.5: Antibacterial properties: To ensure antibacterial properties on the fabrics surfaces, Antimicrobial test done by following ISO 20743-2007, UV-Vis, spectroscopy, scanning electron microscopy(SEM) etc. machines.

2.1.6: Antioxidative properties: Bio-chemical reagent

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3. Result & discussion:

3.1 **Antibacterial:** The term 'antibacterial' refers to an agent that either Destroys various bacteria or slows down their growth. More specifically, there are several ways antibacterial agents may inhibit bacterial growth; for example, by cell wall damage, inhibition of cell wall synthesis or inhibition of the synthesis of proteins and nucleic acids [21,22] or the Drugs which prevent their multiplication or growth, destroy microbes or prevent their pathogenic action [23][13].

3.2Antibacterial properties of Synthesis green bio-molecules encapsulated Ag-NPs:

May be due to ion exchange or reductions (Ag+ ion to Ag0) during reaction between green leaf and AgNO3 color changed yellow to grey, it may be correlated with excitation of surface plasma resonances vibration and happened in the AgNPs [24]. After using agar test found that synthesized bio-molecules encapsulated AgNPs introduce antibacterial properties and inhabitation zone found against Escherichia coli bacteria. So, it may possible to avoid bacterial attack by encapsulated AgNP because bacterial membranes or DNA replication affected by nanoparticles (NPs) disturb [25,26]. The synthesis surface morphology of the particles found to be reproducible & NPs dispersed uniformly and FESEM analysis depicts the potentiality of Artocarpus heterophyllus leaf extract to minimize the aggregation of Ag NPs. Ag NPs were nearly spherical shaped . An intense look at the NPs elucidates that they were mostly encapsulated with a thick layer of organic molecules which emphasized the achievement of one of the goals of the present study, i.e., the attempt of encapsulation of Ag NPs by organic molecules for surface fictionalization of rayon viscose surfaces.

3.3Antibacterial & antioxidative surface of Rayon viscose fabric:
The present of green bio-molecules/AgNPs on the surface of rayon viscose fabric indicates that viscose fabric is antibacterial, bacteria unable to introduce contamination both gram positive and gram negative bacteria i.e. (E.coli) bacteria. Finally, this treatment may accurate solution to solve avoid bacterial attack during wearing such textiles. Anti-oxidative properties also found here by chemical reagent test (agar test).The inhabitation zones are found against both type of bacteria. Synthesized AgNPs have no effect on surfaces also.

Conclusion

Artocarpus heterophyllus leaf extracts of bio-molecules encapsulated AgNPs against bacterial contamination on rayon viscose fabric surfaces are active as an antibiotic and also indicating that functionalized rayon viscose fabric may appreciatable as a medical textile which may not occur infection after wearing or contact with body. We will discuss our next paper details.

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