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# Spiderweb - A Nanosuture Material in the Field of Medicine

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***Abstract:*** ***Spider web is sparkling in sunlight can be a truly beautiful sight. The strength-to-weight ratio of material is remarkable. Cobweb is used as material which is used to synthesize silver nanoparticles. Cobweb was subjected to hydrolysis using a base and web extract was prepared to form a reaction mixture of 10:50 (Extract:$AgNO_3$) solution and silver nanoparticles(SNPs) are synthesized which were dark brown in colour and characterization was done using SEM. Biodegradable sutures were collected and immersed in SNPs of spider web extract and tested for its tensile strength, antibacterial activity with Streptococcus mutants MTCC497 and Staphylococcus aureus ATCC 29213 was evaluated. Characterization of silver ions by SEM analysis showed that particles were rod shaped and size was observed to be less than 180nm. Tensile strength of two different biodegradable sutures were tested which previously showed good tensile strength when they were immersed in SNPs of spider web extract and tested for tensile strength they showed modulus of elasticity. Two sutures broke in a brittle manner, as curve is linear until it breaks or fractures there is no bending observed a thigh loads which concludes that there is no permanent change in original shape during this test and showed no ductility. Antimicrobial tests are done focusing only at skin borne microbes which showed a positive result. The present study showed that biodegradable polymeric sutures available commercially when immersed in SNPs solution showed enhanced antimicrobial properties and showed slight increase in its tensile strength and this material because of its distinct properties can be used as suture material in the field of medicine.***
***Keywords: Silver nanosutures, Tensile strength, Antimicrobial activity***

## I. INTRODUCTION

History of spider web is 100 million years ago as witnesses in a rare find of Early Cretaceous amber from Sussex, Southern England. (1). Cobweb is term used typically to refer to a web which refers to abandoned or dusty webs and it is used oftenly by biologists to describe the tangled three-dimensional web of some spiders of the Theridiidae family(4,5). Spiders belong to subphyla Chelicerata and phylum Arthropoda which include 30,000,000 species of insects alone abundant in all habitats, but they are dominantly present in terrestrial regions and only 2/3 of all species have been described in arthropods(4). Key features of arthropods are jointed appendages, complete exoskeleton, segmental body with specialization of body regions.there are various biomaterials used as implants in human body, sutures constitute largest among them(9). Sutures were widely used in wound closure for many centuries(8). Synthetic absorbable polymer, poly(glycolic acid)(PGA) was used mostly from 1970's as there were no serious attempts of late on a comprehensive review of production, properties, biodegradability, and performance of suture materials. Synthetic absorbable sutures, are copolymers of sugars absorbed slowly by hydrolysis within defined periods of time and well tolerated by tissues, and are found to be resistant to infection and also for biological fluids(3). Aside from advantages of biodegradable polymers used in medicine, such as easier physiological and less intensive repair or the possibility of tissue growth, there are some disadvantages also such as degradation products such as monomers which can be toxic, and can be difficult to sterilize and so forth(10).

It was also discussed that production technology of biodegradable polymer is still immature, and cost of resources such as labor and raw materials in large scale production quantity scale will be comparable high(10,11). Spider silk fibres are an extremely promising candidate for its use in surgical sutures. Silk fibres are braided together because of their maximum tensile strength, stress, strain, elastic modulus, and fatigue response of silk sutures produced using various braiding methods, and braided silk suture was suitable for their use in flexor tendon repair and also provides similar tensile behavior with improved fatigue properties compared to conventional suture materials available(12).

Antibacterial activity was tested for cobweb extract against pathogenic bacteria(6,7). In this study based on ancient healing properties of spider's web, nanoparticles of cobweb were synthesized and characterized and commercially available two different biodegradable polymeric sutures were immersed in synthesized silver nanoparticles and tested for their tensile strength and antibacterial activities for skin borne microbial strains were evaluated.

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## II. MATERIALS

Materials used silver nitrate(himedia, nashik, maharashtra), muller hinton agar(himedia, nashik, maharashtra), ampicillin antibiotic disc(himedia, nashik, maharashtra). Vicryl*plus absorbable surgical suture (ethicon johnson&johnson private limited, aurangabad), mersutures* (catgut) absorbable surgical sutures (ethicon johnson&johnson private limited, aurangabad). And tensile strength apparatus mecmesin(multi test 2.5-*xt*)

## III. METHODS

### *A. Spider Cobweb Collection*

Spider webs used in this study was collected from Shambhavi B block hostel of Alva's college, Moodbidri. Web was taken to laboratory in a sterile container and washed thoroughly using distilled water to remove dust and extraneous materials. Washed web was allowed to dry at room temperature (30±2℃) and kept in air tight container for further use.

### *B. Biological Synthesis Of Silver Nanoparticles*

Synthesis of silver nanoparticles was carried using hydrolysis **Tszydel *et al.*,(2009).**In the present study 0.1 gm of cobweb was subjected to hydrolysis with 40ml of 0.1 N NaOH at 90℃ for 1 hour which was allowed to cool at room temperature and subjected to centrifugation

The supernatant was added to 1mM AgNO3 added to reduce Ag+ ion. This reduction was carried out at room temperature at (30±2℃) for 2 hour and reaction monitored was observed by visual change in colour.

### C. *Characterisation Of Silver Nanoparticles*

The nanoparticles were characterised Scanning Electron Microscopy EVO MA18 with OXFORD EDS with a magnification of 10,00K.

### *D. Tensile Strength*

1) *Preparation Of Sample:* Commercially available absorbable surgical sutures VICRYL* PLUS Absorbable surgical suture (ETHICON JOHNSON&JOHNSON PRIVATE LIMITED, Aurangabad) and MERSUTURES* (CATGUT) Absorbable surgical sutures (ETHICON JOHNSON&JOHNSON PRIVATE LIMITED, Aurangabad). were taken from Alva's Health Centre Moodbidri, Karnataka. And these samples were cut in the length of 0.5cm and were immersed in synthesized SNPs solution and allowed to dry at room temperature for testing their tensile strength
2) *Tensile Strength Test:* Samples prepared were gripped at both ends by MECMESIN(Multi test 2.5- *xt*) a tensile strength apparatus at Alva's Institute Of Engineering Technology(AIET), this apparatus slowly pulls lengthwise on the piece until it fractures. Pulling force is called as a load, which is plotted against the material length change, or displacement.

### *E. Antibacterial Activities Of Synthesised Silver Nanoparticles*

1) *Preparation Of Bacterial Culture:* Freeze dried, *Staphylococcus aureus* ATCC 29213, *Streptococcus mutants* MTCC 497 were activated in specific media and incubated, and pure cultures were maintained under laboratory conditions for further study.
2) *Disc Diffusion Method:* Muller Hinton Agar(HIMEDIA, Nashik, Maharashtra) plates were prepared and bacterial strains were swabbed on plates. This study mainly concentrated on skin born microbes such as *Staphylococcus aureus* ATCC 29213, *Streptococcus mutants* MTCC 497. And disc diffusion method is followed where commercially available VICRYL*PLUS and CATGUT sutures were immersed in different solvents such as Silver nitrate, Silver nanoparticles(SNPs), SNPs added with Glycerol in ratio 1:3, Sample without addition of Silver nitrate and Sample without immersion in any solvents and placed on plates which were incubated at 37ºC for24 hours later zone of inhibition were measured in cm scale.

## IV. RESULTS AND DISCUSSION

### *A. Collection Of Spider Web*

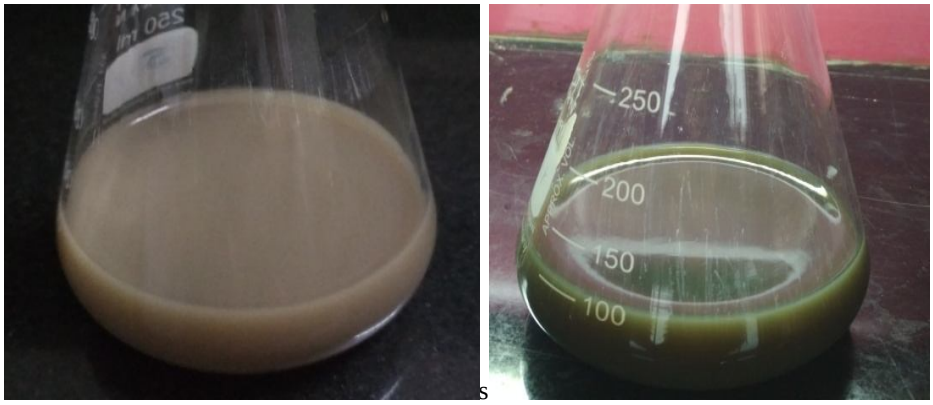
Web sample was collected from Shambhavi B block hostel Alva's College, Moodbidri Karnataka.



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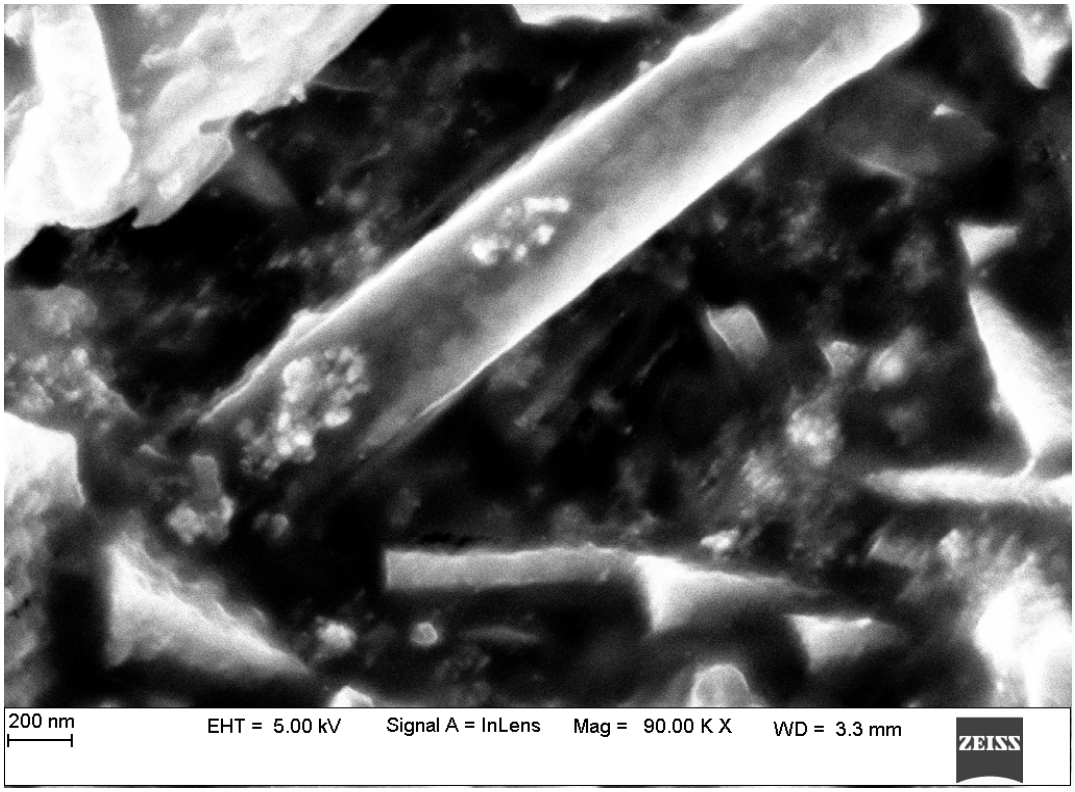
*B. Biological Synthesis Of Silver Nanoparticles*

When cobweb was hydrolyzed with 0.1N NaOH and subjected to centrifugation at 4000 rpm for 30 minutes and web extract which was added to 1mM $AgNO_3$ in ratio (10:50) and left for colour change brown colour was observed which intensified with time.




*C. Characterisation*

*1) Sem Image:* SEM analysis was carried out to characterize the synthesized silver nanoparticles which was subjected to magnification at 10,000 and shape was appeared to be a rod with size less than 180nm.

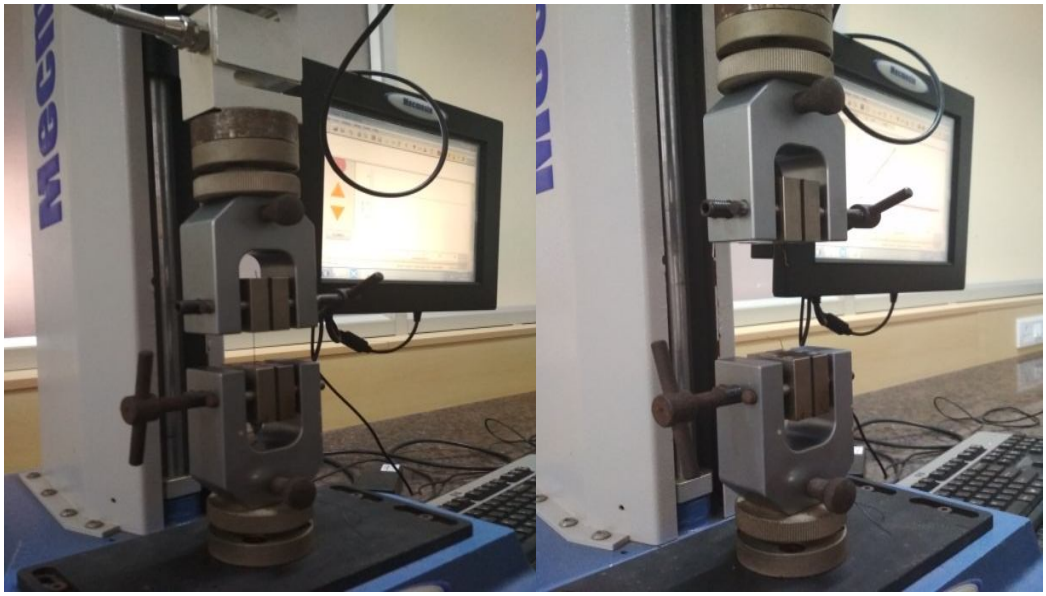


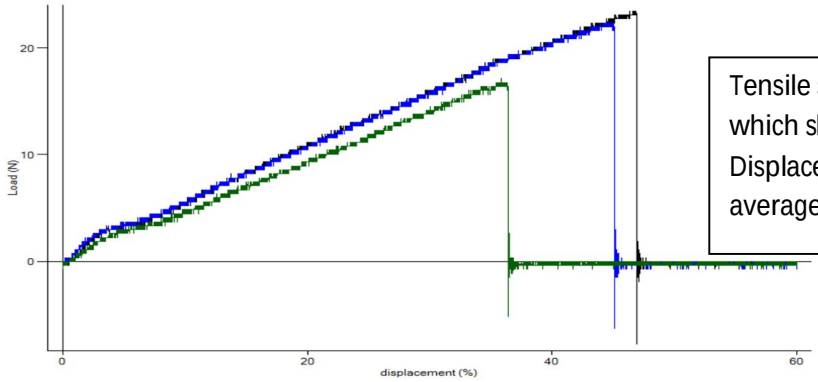

*D. Tensile Strength*

Tensile strength was carried out for two sutures VICRYL* PLUS and CATGUT by MECMESIN(Multi test 2.5-*xt*) which gave results in form of graph of load vs displacement and when average of load and displacement was carried out it showed that CATGUT showed comparatively high tensile strength when they were immersed in SNP solution and when they were tested without immersing in SNP solution they showed similar tensile strength since samples when immersed in SNP solution showed good elongation it can be used as a suture material in medicine.

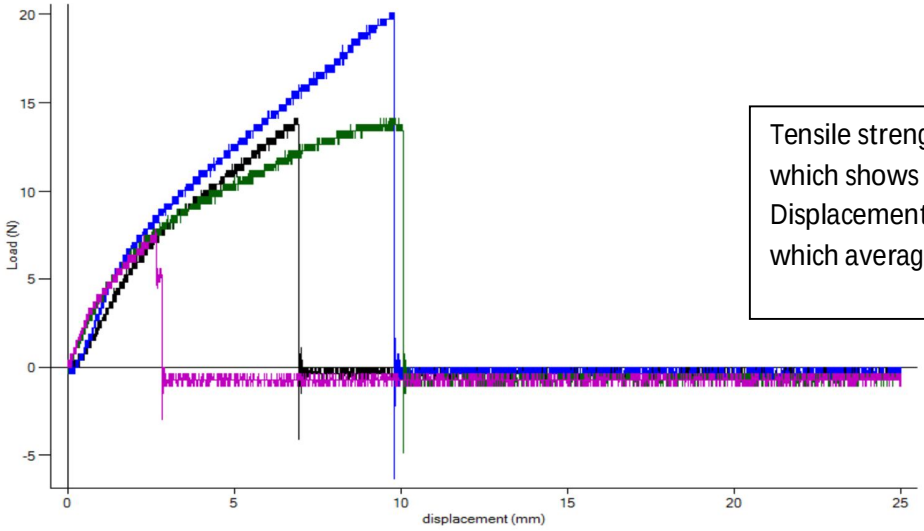
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Tensile strength for VICRYL*PLUS which shows a graph of Load vs Displacement for 3 trials for which average is taken



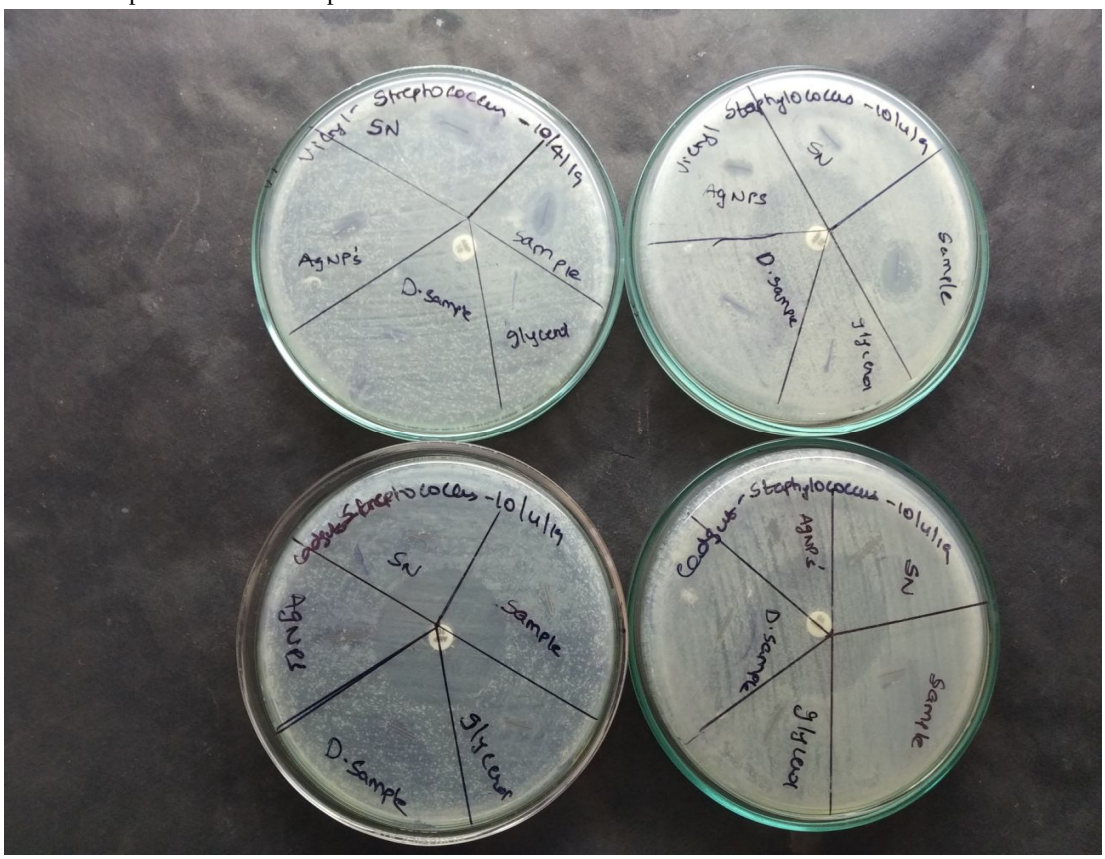

Tensile strength for CATGUT which shows a graph of Load vs Displacement for 4 trials for which average is taken

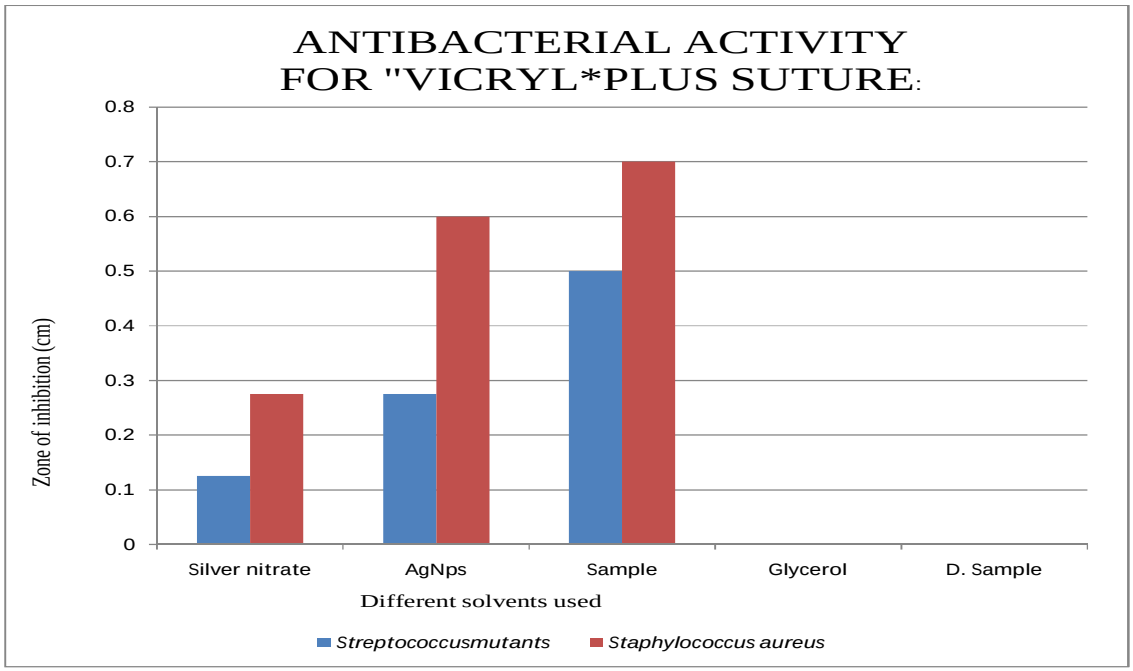
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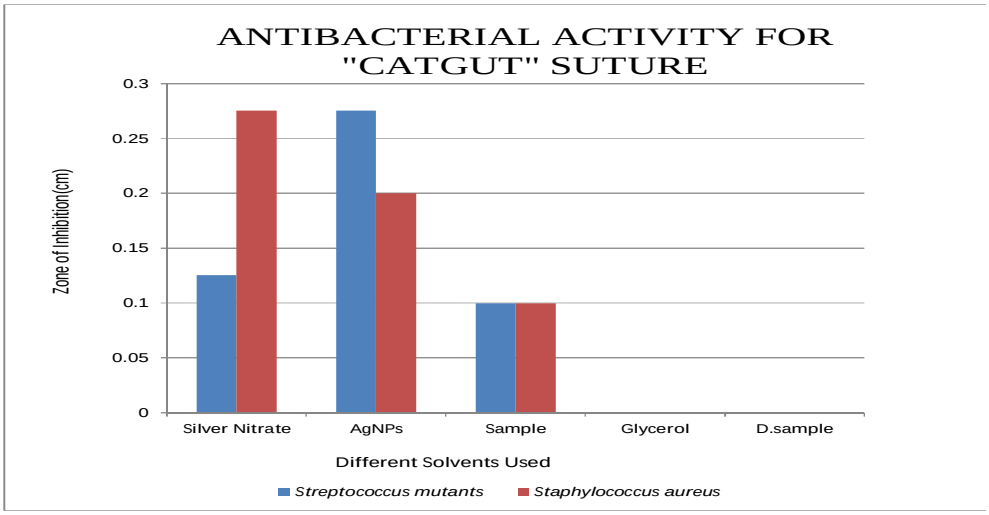
*E. Antibacterial Activity*

Antibacterial activity was carried out only for skin borne microbial strains , *Staphylococcus aureus* ATCC 29213, *Streptococcus mutants* MTCC 497 for VICRY*PLUS and CATGUT sutures of 0.5cm length immersed in various solvents showed that VICRY*PLUS showed a positive result compared to CATGUT .




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## V. SUMMARY AND CONCLUSION

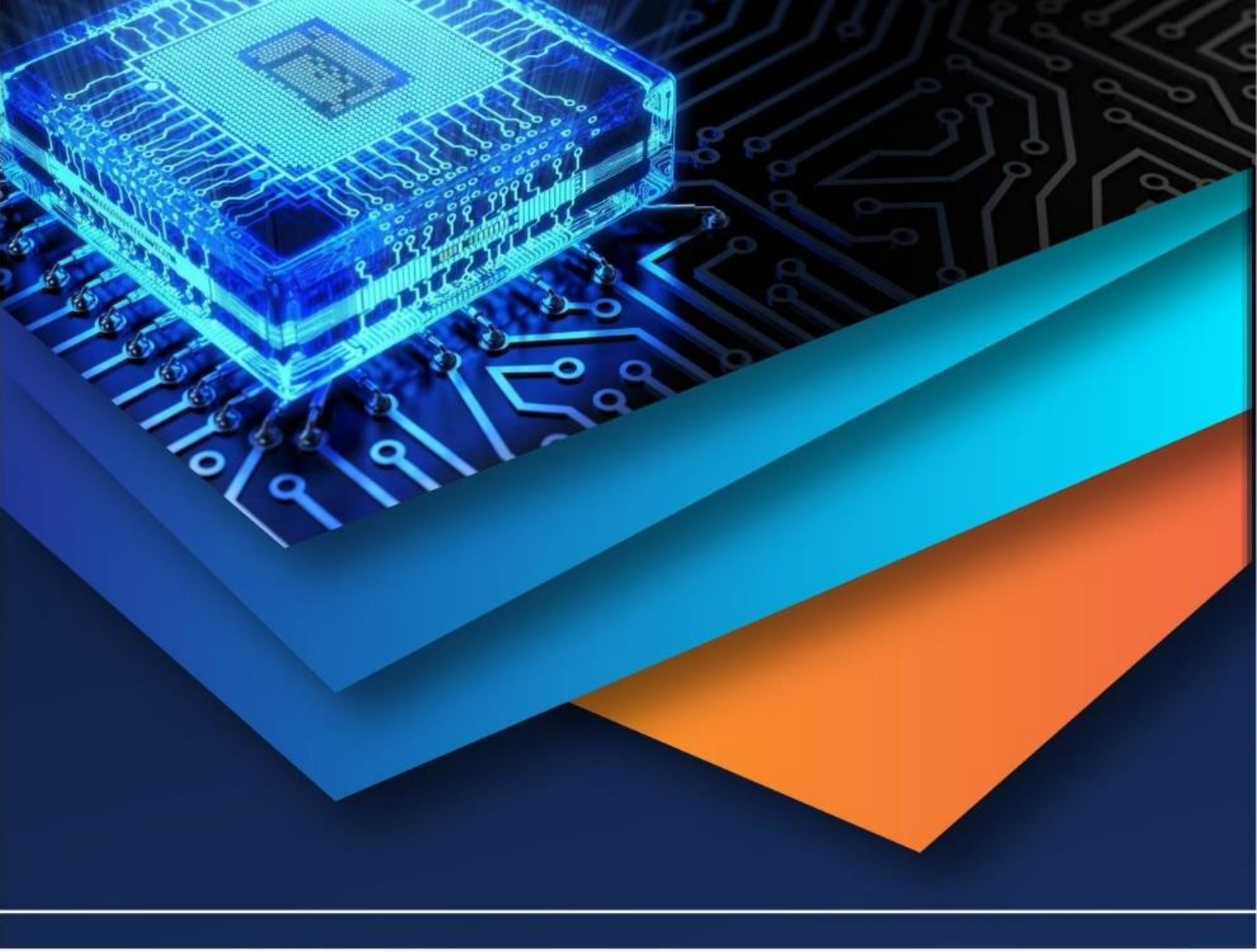
In this present study Cobweb which was subjected to hydrolysis was mediated to synthesis of silver nanoparticles under the ambient room temperature at (30±2°C)

with an apparent visual colour change to dark brown colour which intensified with time . Silver nanoparticles obtained were subjected to SEM analysis, the size of the nanoparticle was 180nm and rod shaped. The commercially available sutures werecollected and immersed in different synthesized SNPs which showed enhanced tensile strength and elongation for CATGUT suture and these suture materials were further evaluated for their antibacterial activity for skin borne microbial strains which showed a very good result for *Staphylococcus aureus* and comparatively VICRYL*PLUS showed good antibacterial property which showed that these can be used as a suture material in field of medicine. Blood clotting factor was tested by using a sample showed its anticoagulant nature naturally spider web have Vitamin-K which usually acts a clotting factor but when it was subjected to nanoscale because of quantum effect it showed anticoagulant behavior which can be used as a thrombolytic during cardiac surgery which help in dissolving clots and can have braod application in the field of medicine.

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