SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPRISM AND ITS ANTIBACTERIAL ACTIVITY AGAINST PSEUDOMONAS AERUGINOSA COMPARED WITH COMMERCIAL ANTIBIOTIC KANAMYCIN

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ABSTRACT

Aim: The primary goal of this study is to synthesize silver nanoprism by biosynthetic approach and its antibacterial activity against *Pseudomonas aeruginosa* as compared with commercial antibiotic Kanamycin. **Materials and Methods:** The sample size of each group is 3 and the total sample size is 6 with $\propto$=0.05, G power 80% and confidence interval 95%. The silver nanoprism has been synthesised by chemical approach andcharacterised by UV visible (UV-Vis) spectroscopy and scanning electron microscopy (SEM). The antibacterial activity was tested against gram negative bacteria *Pseudomonas aeruginosa*. The zone of inhibition has been performed to find the antibacterial activity. **Result:** The antibacterial test shows that the synthesised silver nanoprism concentration (13.5ng/100µl) is statistically significant and the value is 0.001 ($p<0.05$) as compared with antibiotic kanamycin. **Conclusion:** The inhibitory rate of synthesised silver nanoprism is high when compared with antibiotic kanamycin**.** The biosynthesised silver nanoprism is essential for inhibiting bacterial growth and has many applications in the medical field.

KEYWORDS: Silver Nanoprism, Biosynthetic approach, Novel Nanoparticle Synthesis, Antibacterial Activity, Nanotechnology.

1. INTRODUCTION

In this study the biosynthesised silver nanoprism has been prepared and performed antibacterial activity. The biosynthesised silver nanoparticles are prepared from plant extract from *Gossypiumhirsutum*along with ascorbic acid to prepare silver nanoprism. It is a “Green Chemistry" method and it will not pollute the environment (Ghorbanpour et al. 2020). The existing capping agent of the biosynthesised silver nanoprism is virulent on the cells (Chatchawanwirote et al. 2019). The importance of the biosynthesised silver nanoprism has catalysis to infection prevention (Shukla and Iravani 2018). So it can be applied in medical diagnosis applications. The biosynthesised silver nanoprism shows a variety of applications such as antimicrobial, anti inflammatory, and antifungal and photolytic activity (Battistel et al. 2015).

The study of most referred articles have shown that biological synthesis of silver nanoprism has a high ensuring hygiene environment and its antibacterial activity against gram negative bacteria *Pseudomonas aeruginosa* with gentamicin (Lekeshmanaswamy and Anusiyadevi 2020). This study has observed strong antimicrobial activity when compared with gentamicin. Previous study on green synthesis of silver nanoprism from *Alysicarpusmoniliferand* its antibacterial activity has shown the efficient activity against *Pseudomonas aeruginosa*(Kasithevar et al. 2017). In the other study, silver nanoprism are extracted from plant extract of*Psidiumguajava*against gram negative bacteria *Pseudomonas aeruginosa*with kanamycin (Md et al. 2018). From this study the inhibitory rate of the silver nanoprism is high as compared to kanamycin . The best study of the research is the green synthesis of silver nanoprism from*Rheum palmatum*plant extract and its antibacterial activity against *Pseudomonas aeruginosa*(Arokiyaraj et al. 2017). The results show an effective growth of

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inhibition against antibiotics. In these articles the biosynthesised silver nanoprism shows efficient resultsof *Pseudomonas aeruginosa* against antibiotics.

Previously the research group have a rich experience in working on various research projects across multiple disciplines (Ponnulakshmi et al. 2019; Mebin George Mathew et al. 2020; Subramaniam and Muthukrishnan 2019; Girija, Shankar, and Larsson 2020; Dinesh et al. 2020; Thanikodi et al. 2020; Murugan et al. 2020; Vadivel et al. 2019; Chen et al. 2019; Manickam et al. 2019; Wu et al. 2019; Ma et al. 2019; Ponnanikajamideen et al. 2019; Vairavel, Devaraj, and Shanmugam 2020; Paramasivam, VijayashreePriyadharsini, and Raghunandhakumar 2020). Now the growing trend in this area motivated us to pursue this project.Our team has extensive knowledge and research experience that has translate into high quality publications(Patturaja and Pradeep 2016; Ramesh Kumar et al. 2011; Krishnan, Pandian, and Kumar S 2015; Felicita 2017b, [a] 2017; Kumar 2017; Sivamurthy and Sundari 2016; Sathivel et al. 2008; Sekar et al. 2019)

The existing research conveys that biosynthesized silver nanoprism are better used for antimicrobial activity(Thawadi et al. 2017) . Since the nanoprisms are not extracted using other medicinal plant extract found as a research gap by envisaging the research works (Gallardo-Toledo et al. 2020). The authors were expertised in synthesizing the nanoparticles and performing antibacterial activity. The main aim of this study is to examine the antibacterial activity of biosynthesised silver nanoprism against*Pseudomonas aeruginosa*. Direct addition of plant extract from *Gossypiumhirsutu*m as a capping agent at room temperature is a novel approach to synthesis nanoprisms for biomedical applications. The novel nanoparticle synthesis can be achieved by preparing nanoparticles at room temperature levels and is emerging in the field of nanotechnology.

2. MATERIALS AND METHODS

The study setting was conducted at the biochemistry lab in Saveetha School of Engineering. The ethical approval is not concerned for this study. There were two groups taken, the first is biosynthesised silver nanoprism (AgNps) with N=3 and the second is kanamycin N=3. The sample size was calculated using Clincalc.com with $\propto$=0.05, G power 80% and confidence interval 95% (Mama, Teshome, and Detamo 2019). The materials used in this study are biosynthesized silver nanoparticles ,ascorbic acid , and distilled water.

As per the standard procedure the plant extract of the*Gossypiumhirsutum* has been extracted using filter extraction methods (Aritonang, Koleangan, and Wuntu 2019). The synthesis of silver nanoprism is done as per the standard procedure (Chakotiya et al. 2016) as a group1 and the commercial antibiotic kanamycin purchased from SRLlaboratory as a group 2. The antibacterial activity against *Pseudomonas aeruginosa* was done as per the standard procedure (D. et al. 2018).

The samples were prepared by taking 2mL of silver nanoparticles and keeping it in the sample cell. After, the sample was analyzed using a UV-Visible spectrophotometer. The samples were subjected to scanning electron microscopy (SEM) by placing a drop of nanoparticles on silicon wafers. The data was collected based on absorbance (a.u) and size (nm).

Statistical analysis
The statistical analysis is done by using IBM-SPSS (Statistical package for social science). An independent t test has been performed in this study and is used to identify the difference in the significant values. The dependent variable is the zone of inhibition and the independent variable is room temperature.

3. RESULT

Figure 1 represents the synthesis of silver nanoprism by biosynthetic approach at room temperature using biosynthesized silver nanoparticles from plant extract of*Gossypiumhirsutum*and ascorbic acid.The colour indicates reddish yellow and is not the usual colour appeared by the nanoparticles upon this synthetic method. The colour change indicates the presence of silver nanoprism in the solution. Fig. 2 shows the UV-visible spectrum of biosynthesised silver nanoprism and observed absorbance ranges from 200 to 1000 nm. The peak of absorbance can be seen at 280, 360 and 440 nm. The absorbance of the UV-visible spectrum denotes the concentration of silver nanoprism. If the concentration of silver nanoprism is high, the absorbance intensity will also be high. The green synthesis of silver nanoprism has the chromatic changes from green to brown colour that denotes the transformation of Ag^{+} ion to Ag^{0} atoms. The Fig. 3 represents the visualisation of biosynthesised silver nanoprism under scanning electron microscopes. The image shows the morphology of biosynthesised

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silver nanoprism and its resolution and shape of the image. Theelectron high tension used for the analysis is 20.00kV and the magnification is 10.00K X and the scale bar is 1µm. The Fig. 4a shows the solidified nutrient agar medium prepared for antibacterial test. The Fig. 4b represents the antibacterial test of biosynthesised silver nanoprism against the gram negative bacteria *Pseudomonas aeruginosa*with antibiotic kanamycin as a control and its zone of inhibition**.**

Table 1 shows the comparison of zones of inhibition with different types of concentrations. The zone of inhibition was calculated from Kanamycin (commercial antibiotic) and biosynthesized silver nanoprism. At higher concentration, the biosynthesized silver nanoprism shows a higher inhibitory effect for 13.5ng/100 µl is about 880mm. Table 2 shows the group statistics of the comparison of kanamycin with biosynthesized nanoprism. The study shows higher mean for biosynthesized nanoprism about 760.00. Table 3 shows the comparison of biosynthesised silver nanoprism in terms of antibacterial activity against *Pseudomonas aeruginosa* with antibiotic kanamycin by independent sample test. Biosynthesised silver nanoprism have statistically significant values (<0.001) as compared with commercial antibiotics. Fig. 5 shows the bar graph of biosynthesised silver nanoprism and kanamycin in terms of concentration and zone of inhibition. Antibacterial activity was performed against *Pseudomonas aeruginosa*bacteria in the presence of antibiotic kanamycin. Biosynthesised silver nanoprism shows better antibacterial activity (zone of inhibition) than antibiotic, kanamycin.

Statistical analysis was performed for six samples of kanamycin and biosynthesized silver nanoprism having mean of 166.00 and 760.00 with standard deviation 0.250 and 120.00000 respectively for antibacterial test. The value of 'p' is smaller than α, 0.05 that shows statistically significant and hence the null hypothesis is rejected. The test implies that there is no similar mean for kanamycin and biosynthesized silver nanoprism. Independent t-test was used to compare the inhibitory effect of kanamycin and biosynthesized silver nanoprism, a statistical significance was noticed as 0.001($p<0.05$).

4. DISCUSSION

In this study biosynthesised silver nanoprism shows the efficient result in antibacterial tests against *pseudomonas aeruginosa* with the concentration 13.5ng/100µl. The similar findings were foundin the synthesis of silver nanoprism by green synthesis approach and its antibacterial activity against *Pseudomonas aeruginosa.* In this study the green synthesised silver nanoprism shows the efficient inhibitory rate against gram negative bacteria *pseudomonas aeruginosa* and control gentamicin (Senthilkumar et al. 2018). The study of similar findings have shown the synthesis of silver nanoparticles by biosynthetic approach from *Rosa indica* and its antibacterial activity against *Pseudomonas aeruginosa*. From this study, the biosynthesised silver nanoprism showed the efficient growth of inhibition against *Pseudomonas aeruginosa*(Schito and Alfei 2020).The opposite finding has not shown potential antibacterial activity on higher concentration 72.5mg/100µl (Kim 2020). The lower concentration of silver nanoprism will result in efficient antibacterial activity. So the increase in concentration of silver nanoprism may lead to toxicity and may show adverse risk on human health and environment.

At room temperature synthesis of silver nanoparticles shows green colour. In this study the colour of the nanoparticle is reddish yellow. This is due to the presence of silver nanoprism in the solution (Zuo et al. 2020). The chemically synthesized silver nanoprism have maximum absorbance at 400-420nm (Khan and Javed 2021). In this research study we also get the absorbance at 280, 360 and 440nm. This may lead to the presence of silver ions which are not converted to silver atoms.

Saveetha School of Engineering is passionate about high quality evidence based research and has excelled in various fields (VijayashreePriyadharsini 2019; Ezhilarasan, Apoorva, and Ashok Vardhan 2019; Ramesh et al. 2018; M. G. Mathew et al. 2020; Sridharan et al. 2019; Pc, Marimuthu, and Devadoss 2018; Ramadurai et al. 2019). We hope this study adds to this rich legacy.

The limitation of the biosynthesized nanoprism shows long-term exposure to Ag has been linked to irreversible diseases including argyria, in which the skin turns bluish in hue as a result of Ag buildup in human tissue, according to occupational health research. The factors affecting this study are size, shape, concentration and temperature. The nanoprism show heterogeneity due to its high absorbance intensity will produce different results for different sizes of the nanoparticles. Also the biosynthesized silver nanoprism shows vital genotoxicity.

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The biosynthesised silver nanoprism can be applied in antimicrobial compounds in future and have applications *in-vivo* biologicalapplication, optoelectronics, drug delivery system and therapeutic agents in nanomedicines.

5. CONCLUSION

The study reveals that the biosynthesised silver nanoprism has the most efficient activity in the antibacterial test against gram negative bacteria *Pseudomonas aeruginosa* as compared with commercial antibiotic kanamycin.

DECLARATIONS

Conflict of interests
No conflict of interest in this manuscript.

Author's contributions
Author DS was involved in data collection, data analysis, and manuscript writing. Author GP was involved in conceptualization, data validation and critical review of manuscript.

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6. REFERENCES

[1]. Aritonang, Henry F., Harry Koleangan, and Audy D. Wuntu. 2019. “Synthesis of Silver Nanoparticles Using Aqueous Extract of Medicinal Plants’ (Impatiens Balsamina and Lantana Camara) Fresh Leaves and Analysis of Antimicrobial Activity.” *International Journal of Microbiology* 2019 (July). https://doi.org/10.1155/2019/8642303.

[2]. Arokiyaraj, Selvaraj, Savariar Vincent, MuthupandianSaravanan, Yoonseok Lee, Young Kyoon Oh, and KyoungHoon Kim. 2017. “Green Synthesis of Silver Nanoparticles Using Rheum Palmatum Root Extract and Their Antibacterial Activity against Staphylococcus Aureus and Pseudomonas Aeruginosa.” *Artificial Cells, Nanomedicine, and Biotechnology* 45 (2): 372–79.

[3]. Battistel, Dario, Franco Baldi, Michele Gallo, Claudia Faleri, and Salvatore Daniele. 2015. “Characterisation of Biosynthesised Silver Nanoparticles by Scanning Electrochemical Microscopy (SECM) and Voltammetry.” *Talanta*. https://doi.org/10.1016/j.talanta.2014.09.023.

[4]. Chakotiya, Ankita Singh, Raman Chawla, Pallavi Thakur, AnkitTanwar, AlkaNarula, Shyam Sunder Grover, Rajeev Goel, Rajesh Arora, and Rakesh Kumar Sharma. 2016. “In Vitro Bactericidal Activity of Promising Nutraceuticals for Targeting Multidrug Resistant Pseudomonas Aeruginosa.” *Nutrition* 32 (7-8): 890–97.

[5]. Chatchawanwirote, Lalitpun, Piyachat Chuysinuan, Thanyaluck Thanyacharoen, Pongpol Ekabutr, and Pitt Supaphol. 2019. “Green Synthesis of Photomediated Silver Nanoprisms via a Light-Induced Transformation Reaction and Silver Nanoprism-

DOI: 10.9756/INT-JECSE/V14I3.709

Impregnated Bacteria Cellulose Films for Use as Antibacterial Wound Dressings." *Journal of Drug Delivery Science and Technology*. https://doi.org/10.1016/j.jddst.2019.101305.

[6]. Chen, Feng, Ying Tang, Yujia Sun, Vishnu PriyaVeeraraghavan, Surapaneni Krishna Mohan, and Chuanxin Cui. 2019. "6-Shogaol, a Active Constiuents of Ginger Prevents UVB Radiation Mediated Inflammation and Oxidative Stress through Modulating NrF2 Signaling in Human Epidermal Keratinocytes (HaCaT Cells)." *Journal of Photochemistry and Photobiology. B, Biology* 197 (August): 111518.

[7]. Dinesh, S., P. Kumaran, S. Mohanamurugan, R. Vijay, D. Lenin Singaravelu, A. Vinod, M. R. Sanjay, Suchart Siengchin, and K. Subrahmanya Bhat. 2020. "Influence of Wood Dust Fillers on the Mechanical, Thermal, Water Absorption and Biodegradation Characteristics of Jute Fiber Epoxy Composites." *Journal of Polymer Research* 27 (1). https://doi.org/10.1007/s10965-019-1975-2.

[8]. D., Nik Nur Shamiha N., Nik Nur Shamiha N, Ghayatery Nagatamby, Jiyauddin Khan, Fadli Asmani, and Eddy Yusuf. 2018. "The Antibacterial Activity of Isolated Flavonoid Fractions from Ethanol Ethanolic Peel of Citrus Sinensis (Valencia Orange) with Citrus Limon (Lemon) against Staphylococcus Aureus and Pseudomonas Aeruginosa." *Proceedings of BROMO Conference*. https://doi.org/10.5220/0008359801940197.

[9]. Ezhilarasan, Devaraj, Velluru S. Apoorva, and Nandhigam Ashok Vardhan. 2019. "SyzygiumCumini Extract Induced Reactive Oxygen Species-Mediated Apoptosis in Human Oral Squamous Carcinoma Cells." *Journal of Oral Pathology & Medicine: Official Publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology* 48 (2): 115–21.

[10]. Felicita, A. Sumathi. 2017a. "Quantification of Intrusive/retraction Force and Moment Generated during En-Masse Retraction of Maxillary Anterior Teeth Using Mini-Implants: A Conceptual Approach." *Dental Press Journal of Orthodontics* 22 (5): 47–55.

[11]. ———. 2017b. "Orthodontic Management of a Dilacerated Central Incisor and Partially Impacted Canine with Unilateral Extraction - A Case Report." *The Saudi Dental Journal* 29 (4): 185–93.

[12]. Gallardo-Toledo, Eduardo, Andreas Tapia-Arellano, Freddy Celis, Tomer Sinai, Marcelo Campos, Marcelo J. Kogan, and Amnon C. Sintov. 2020. "Intranasal Administration of Gold Nanoparticles Designed to Target the Central Nervous System: Fabrication and Comparison between Nanospheres and Nanoprisms." *International Journal of Pharmaceutics* 590 (November): 119957.

[13]. Ghorbanpour, Mansour, Prachi Bhargava, AjitVarma, and Devendra K. Choudhary. 2020. *Biogenic Nano-Particles and Their Use in Agro-Ecosystems*. Springer Nature.

[14]. Girija, A. S. Smiline, Esaki M. Shankar, and Marie Larsson. 2020. "Could SARS-CoV-2-Induced Hyperinflammation Magnify the Severity of Coronavirus Disease (CoViD-19) Leading to Acute Respiratory Distress Syndrome?" *Frontiers in Immunology*.

[15]. Kasithevar, Muthupandi, Muthupandian Saravanan, Periyakaruppan Prakash, Hema Kumar, Muhammad Ovais, Hamed Barabadi, and Zabta Khan Shinwari. 2017. "Green Synthesis of Silver Nanoparticles Using Alysicarpus Monilifer Leaf Extract and Its Antibacterial Activity against MRSA and CoNS Isolates in HIV Patients." *Journal of Interdisciplinary Nanomedicine*. https://doi.org/10.1002/jin2.26.

[16]. Khan, Kashan, and Saleem Javed. 2021. "Silver Nanoparticles Synthesized Using Leaf Extract of Azadirachta Indica Exhibit Enhanced Antimicrobial Efficacy than the

DOI: 10.9756/INT-JECSE/V14I3.709

Chemically Synthesized Nanoparticles: A Comparative Study." *Science Progress*. https://doi.org/10.1177/00368504211012159.

[17]. Kim, Yongae. 2020. "NMR Structural Studies and Antibacterial Killing Mechanisms of Antimicrobial Peptides with Higher Activity." *Biophysical Journal*. https://doi.org/10.1016/j.bpj.2019.11.1393.

[18]. Krishnan, Sindhuja, SaravanaPandian, and Aravind Kumar S. 2015. "Effect of Bisphosphonates on Orthodontic Tooth Movement-an Update." *Journal of Clinical and Diagnostic Research: JCDR* 9 (4): ZE01–05.

[19]. Kumar, Santhosh. 2017. "The Emerging Role of Botulinum Toxin in the Treatment of Orofacial Disorders: Literature Update." *Asian Journal of Pharmaceutical and Clinical Research* 10 (9): 21.

[20]. Lekeshmanaswamy, M., and K. Anusiyadevi. 2020. "Biosynthesis of Silver Nanoparticles Using Pergularia Daemia (Hamilton, 1822) Leaf Extract and Its Enhanced Antibacterial Activity against Gram Negative Bacteria (Escherichia Coli)." *Materials Today: Proceedings*. https://doi.org/10.1016/j.matpr.2020.06.499.

[21]. Mama, Mohammedaman, TekluTeshome, and JaferDetamo. 2019. "Antibacterial Activity of Honey against Methicillin-Resistant : A Laboratory-Based Experimental Study." *International Journal of Microbiology* 2019 (April): 7686130.

[22]. Manickam, Adhiyaman, EzhilmaranDevarasan, GunasekaranManogaran, Malarvizhi Kumar Priyan, R. Varatharajan, Ching-Hsien Hsu, and Raja Krishnamoorthi. 2019. "Score Level Based Latent Fingerprint Enhancement and Matching Using SIFT Feature." *Multimedia Tools and Applications* 78 (3): 3065–85.

[23]. Mathew, Mebin George, S. R. Samuel, AshuJagdishSoni, and KorishettarBasavarajRoopa. 2020. "Evaluation of Adhesion of Streptococcus Mutans, Plaque Accumulation on Zirconia and Stainless Steel Crowns, and Surrounding Gingival Inflammation in Primary Molars: Randomized Controlled Trial." *Clinical Oral Investigations* 24 (9): 3275–80.

[24]. Mathew, M. G., S. R. Samuel, A. J. Soni, and K. B. Roopa. 2020. "Evaluation of Adhesion of Streptococcus Mutans, Plaque Accumulation on Zirconia and Stainless Steel Crowns, and Surrounding Gingival Inflammation in Primary …." *Clinical Oral Investigations*. https://link.springer.com/article/10.1007/s00784-020-03204-9.

[25]. Ma, Yunhai, ThiruventhanKarunakaran, Vishnu PriyaVeeraraghavan, Surapaneni Krishna Mohan, and Shuling Li. 2019. "Sesame Inhibits Cell Proliferation and Induces Apoptosis through Inhibition of STAT-3 Translocation in Thyroid Cancer Cell Lines (FTC-133)." *Biotechnology and Bioprocess Engineering: BBE* 24 (4): 646–52.

[26]. Md, Dr Beulah Edwin, Dr Beulah Edwin, Associate Professor, Dept of Microbiology, Tagore Medical College and Hospital, Chennai -, and India. 2018. "Antibacterial Activity of Psidium Guajava L. against Certain Multidrug Resistant Gram-Negative and Gram-Positive Bacteria." *Journal of Medical Science And Clinical Research*. https://doi.org/10.18535/jmscr/v6i9.29.

[27]. Murugan, M. Arul, V. Jayaseelan, D. Jayabalakrishnan, T. Maridurai, S. Selva Kumar, G. Ramesh, and V. R. Arun Prakash. 2020. "Low Velocity Impact and Mechanical Behaviour of Shot Blasted SiC Wire-Mesh and Silane-Treated Aloevera/hemp/flax-Reinforced SiC Whisker Modified Epoxy Resin Composites." *Silicon Chemistry* 12 (8): 1847–56.

[28]. Paramasivam, Arumugam, JayaseelanVijayashreePriyadharsini, and Subramanian Raghunandhakumar. 2020. "N6-Adenosine Methylation (m6A): A Promising New

DOI: 10.9756/INT-JECSE/V14I3.709

Molecular Target in Hypertension and Cardiovascular Diseases." *Hypertension Research: Official Journal of the Japanese Society of Hypertension* 43 (2): 153–54.

[29]. Patturaja, Kiruthika, and D. Pradeep. 2016. "Awareness of Basic Dental Procedure among General Population." *Journal of Advanced Pharmaceutical Technology & Research* 9 (9): 1349.

[30]. Pc, J., T. Marimuthu, and P. Devadoss. 2018. "Prevalence and Measurement of Anterior Loop of the Mandibular Canal Using CBCT: A Cross Sectional Study." *Clinical Implant Dentistry and Related Research*. https://europepmc.org/article/med/29624863.

[31]. Ponnanikajamideen, Mohamedibrahim, ShanmugamRajeshkumar, MahendranVanaja, and GurusamyAnnadurai. 2019. "In Vivo Type 2 Diabetes and Wound-Healing Effects of Antioxidant Gold Nanoparticles Synthesized Using the Insulin Plant ChamaecostusCuspidatus in Albino Rats." *Canadian Journal of Diabetes* 43 (2): 82–89.e6.

[32]. Ponnulakshmi, R., B. Shyamaladevi, P. Vijayalakshmi, and J. Selvaraj. 2019. "In Silico and in Vivo Analysis to Identify the Antidiabetic Activity of Beta Sitosterol in Adipose Tissue of High Fat Diet and Sucrose Induced Type-2 Diabetic Experimental Rats." *Toxicology Mechanisms and Methods* 29 (4): 276–90.

[33]. Ramadurai, Neeraja, DeepaGurunathan, A. Victor Samuel, Emg Subramanian, and Steven J. L. Rodrigues. 2019. "Effectiveness of 2% Articaine as an Anesthetic Agent in Children: Randomized Controlled Trial." *Clinical Oral Investigations* 23 (9): 3543–50.

[34]. Ramesh, Asha, Sheeja Varghese, Nadathur D. Jayakumar, and SankariMalaiappan. 2018. "Comparative Estimation of Sulfiredoxin Levels between Chronic Periodontitis and Healthy Patients - A Case-Control Study." *Journal of Periodontology* 89 (10): 1241–48.

[35]. Ramesh Kumar, K. R., K. K. ShantaSundari, A. Venkatesan, and ShymalaaChandrasekar. 2011. "Depth of Resin Penetration into Enamel with 3 Types of Enamel Conditioning Methods: A Confocal Microscopic Study." *American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics* 140 (4): 479–85.

[36]. Sathivel, Arumugam, Hanumantha Rao BalajiRaghavendran, Periasamy Srinivasan, and ThiruvengadamDevaki. 2008. "Anti-Peroxidative and Anti-Hyperlipidemic Nature of UlvaLactuca Crude Polysaccharide on D-Galactosamine Induced Hepatitis in Rats." *Food and Chemical Toxicology: An International Journal Published for the British Industrial Biological Research Association* 46 (10): 3262–67.

[37]. Schito, Anna Maria, and Silvana Alfei. 2020. "Antibacterial Activity of Non-Cytotoxic, Amino Acid-Modified Polycationic Dendrimers against Pseudomonas Aeruginosa and Other Non-Fermenting Gram-Negative Bacteria." *Polymers*. https://doi.org/10.3390/polym12081818.

[38]. Sekar, Durairaj, Ganesh Lakshmanan, Panagal Mani, and M. Biruntha. 2019. "Methylation-Dependent Circulating microRNA 510 in Preeclampsia Patients." *Hypertension Research: Official Journal of the Japanese Society of Hypertension* 42 (10): 1647–48.

[39]. Senthilkumar, P., S. Rashmitha, Priscilla Veera, C. Ignatious, C. SaiPriya, and Antony Samrot. 2018. "Antibacterial Activity of Neem Extract and Its Green Synthesized Silver Nanoparticles against Pseudomonas Aeruginosa." *Journal of Pure and Applied Microbiology*. https://doi.org/10.22207/jpam.12.2.60.

DOI: 10.9756/INT-JECSE/V14I3.709

[40]. Shukla, Ashutosh Kumar, and SiavashIravani. 2018. *Green Synthesis, Characterization and Applications of Nanoparticles*. Elsevier.
[41]. Sivamurthy, Gautham, and ShanthaSundari. 2016. "Stress Distribution Patterns at Mini-Implant Site during Retraction and Intrusion—a Three-Dimensional Finite Element Study." *Progress in Orthodontics* 17 (1): 1–11.
[42]. Sridharan, Gokul, PratibhaRamani, SangeetaPatankar, and RajagopalanVijayaraghavan. 2019. "Evaluation of Salivary Metabolomics in Oral Leukoplakia and Oral Squamous Cell Carcinoma." *Journal of Oral Pathology & Medicine: Official Publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology* 48 (4): 299–306.
[43]. Subramaniam, Nandhini, and ArvindMuthukrishnan. 2019. "Oral Mucositis and Microbial Colonization in Oral Cancer Patients Undergoing Radiotherapy and Chemotherapy: A Prospective Analysis in a Tertiary Care Dental Hospital." *Journal of Investigative and Clinical Dentistry* 10 (4): e12454.
[44]. Thanikodi, Sathish, Dinesh Singaravelu Kumar, ChandramohanDevarajan, VijayanVenkatraman, and VenkateshRathinavelu. 2020. "Teaching Learning Optimization and Neural Network for the Effective Prediction of Heat Transfer Rates in Tube Heat Exchangers." *Thermal Science* 24 (1 Part B): 575–81.
[45]. Thawadi, Salwa Al, Salwa Al Thawadi, Alaa Shukralla A. Rasool, and Khaled Youssef. 2017. "Antimicrobial Activity of Biosynthesized Silver Nanoparticles against E. Coli and B. Subtilis." *Journal of Bioanalysis & Biomedicine*. https://doi.org/10.4172/1948-593x.1000197.
[46]. Vadivel, Jayanth Kumar, MeeraGovindarajan, ElangovanSomasundaram, and ArvindMuthukrishnan. 2019. "Mast Cell Expression in Oral Lichen Planus: A Systematic Review." *Journal of Investigative and Clinical Dentistry* 10 (4): e12457.
[47]. Vairavel, Mathivadani, EzhilarasanDevaraj, and RajeshkumarShanmugam. 2020. "An Eco-Friendly Synthesis of Enterococcus Sp.-Mediated Gold Nanoparticle Induces Cytotoxicity in Human Colorectal Cancer Cells." *Environmental Science and Pollution Research International* 27 (8): 8166–75.
[48]. VijayashreePriyadharsini, Jayaseelan. 2019. "In Silico Validation of the Non-Antibiotic Drugs Acetaminophen and Ibuprofen as Antibacterial Agents against Red Complex Pathogens." *Journal of Periodontology* 90 (12): 1441–48.
[49]. Wu, Fenglian, Jun Zhu, Guoliang Li, Jiaxin Wang, Vishnu PriyaVeeraraghavan, Surapaneni Krishna Mohan, and Qingfu Zhang. 2019. "Biologically Synthesized Green Gold Nanoparticles from Induce Growth-Inhibitory Effect on Melanoma Cells (B16)." *Artificial Cells, Nanomedicine, and Biotechnology* 47 (1): 3297–3305.
[50]. Zuo, Yunfeng, Longfei Chen, Xuejia Hu, Fang Wang, and Yi Yang. 2020. "Silver Nanoprism Enhanced Colorimetry for Precise Detection of Dissolved Oxygen." *Micromachines*. https://doi.org/10.3390/mi11040383.

TABLES AND FIGURES

Table 1: Comparison of zone of inhibition with different types of concentration with the kanamycin and biosynthesised silver nanoprism. In the below table the biosynthesised silver nanoprism shows the highest zone of inhibition (880mm) with the concentration of 13.5ng/100µl.

Sample	**Concentration**	**ZOI(mm)**

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Kanamycin	165.75µg /10µl	6
	166.00µg /50µl	33
Biosynthesised silver nanoprism	166.25µg /100µl	66
	2.2ng/10µl	640
	3.5ng/50µl	740
	13.5ng/100µl	880

Table 2: Comparison of biosynthesised silver nanoprism and kanamycin in terms of antibacterial activity by group statistics. The below table shows the highest zone of inhibition for the biosynthesised silver nanoprism value is 760.0000

	Group	**N**	**Mean**	**Std Deviation**	**Std Error Mean**
Kanamycin	Concentration	3	166.0000	.25000	.14434
	ZOI	3	35.0000	30.04996	17.34935
AgNps	Concentration	3	6.7333	5.97188	3.44787
	ZOI	3	760.0000	120.00000	69.28203

Table 3: Independent t test of biosynthesised silver nanoprism and kanamycin which are used in antibacterial activity. The biosynthesised silver nanoparticle shows the significant value is 0.001 ($p<0.05$).

	F		**Sig**	**t**	**df**	**Sig (2 tailed)**	**Mean difference**	**Std Error difference**	**Lower**	**Upper**
Kanamycin	Equal Variances Assumed	2.086	.094	10.151	4	.022	-159.2666	3.45089	168.84786	-149.68547
	Equal Variances Not Assumed			10.151	2	.017	-159.26667	3.45089	174.06504	-144.46829
Silver nanoprism	Equal Variance	4.590	.099	46.152	4	<.001	725.00000	71.42129	526.70272	923.29728

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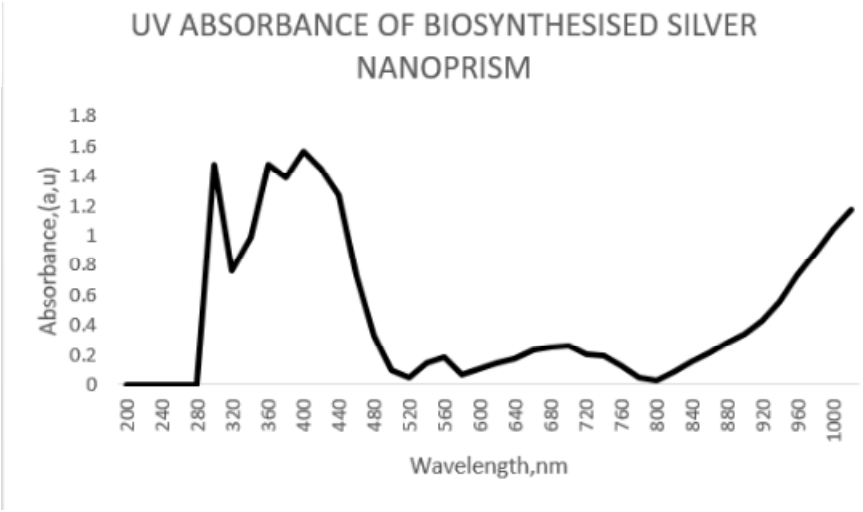
	s Assumed									
	Equal Variances Not Assumed			46.152	2.011	.008	725.00000	71.42129	448,19316	1001.80684

Fig. 1. Biosynthesized silver nano prism. The synthesis involves direct mixing of biosynthesised silver nanoparticles and ascorbic acid in the presence of *Gossypiumhirsutum*extract as a capping agent. The



nanoparticles show reddish yellow colour.

Fig. 2. UV- Visible spectrum of biosynthesized silver nanoprism. The spectrum was analyzed from 200-1000 nm. It shows that the particles absorb in the visible region.

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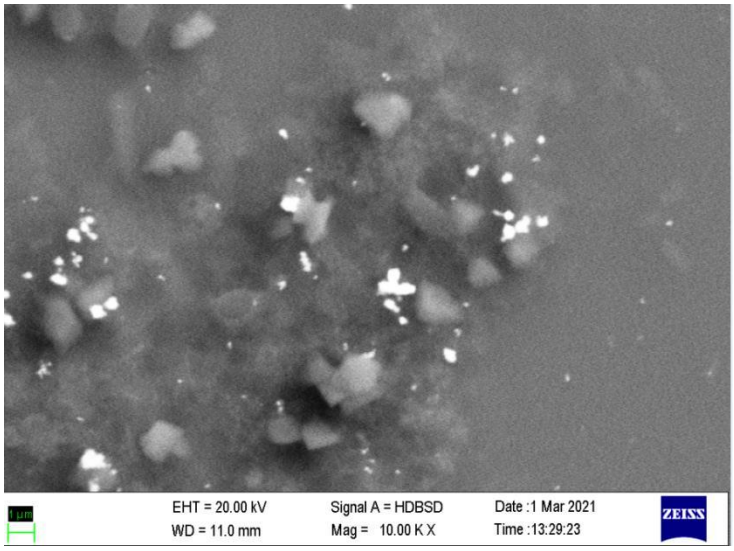

Fig. 3. Morphology of biosynthesised silver nanoprism. The sample was subjected to analyze morphology using SEM. Particles showed spherical and crystallite shapes.

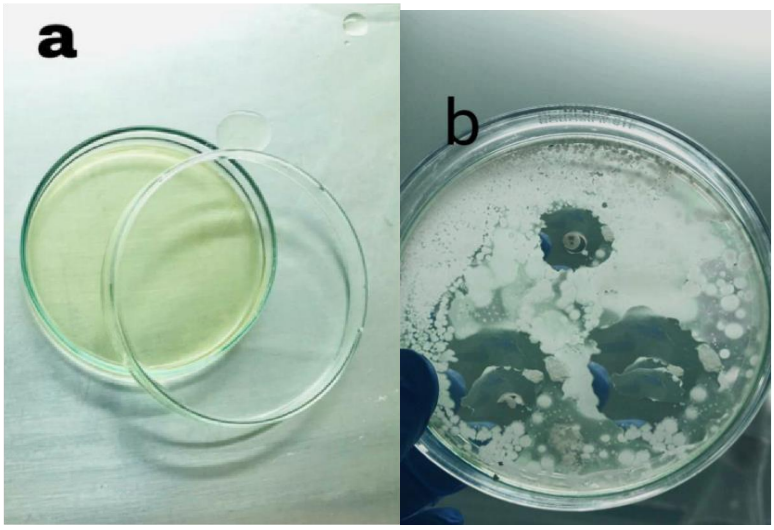

Fig. 4a. Nutrient Agar Medium. **Fig. 4b.** BiosynthesisedAgNnanoprisms

Fig. 4a. Nutrient Agar Medium. **Fig. 4b.** Biosynthesised silver nanoprism antibacterial test. The solidified agar was punctured to perform antibacterial tests.

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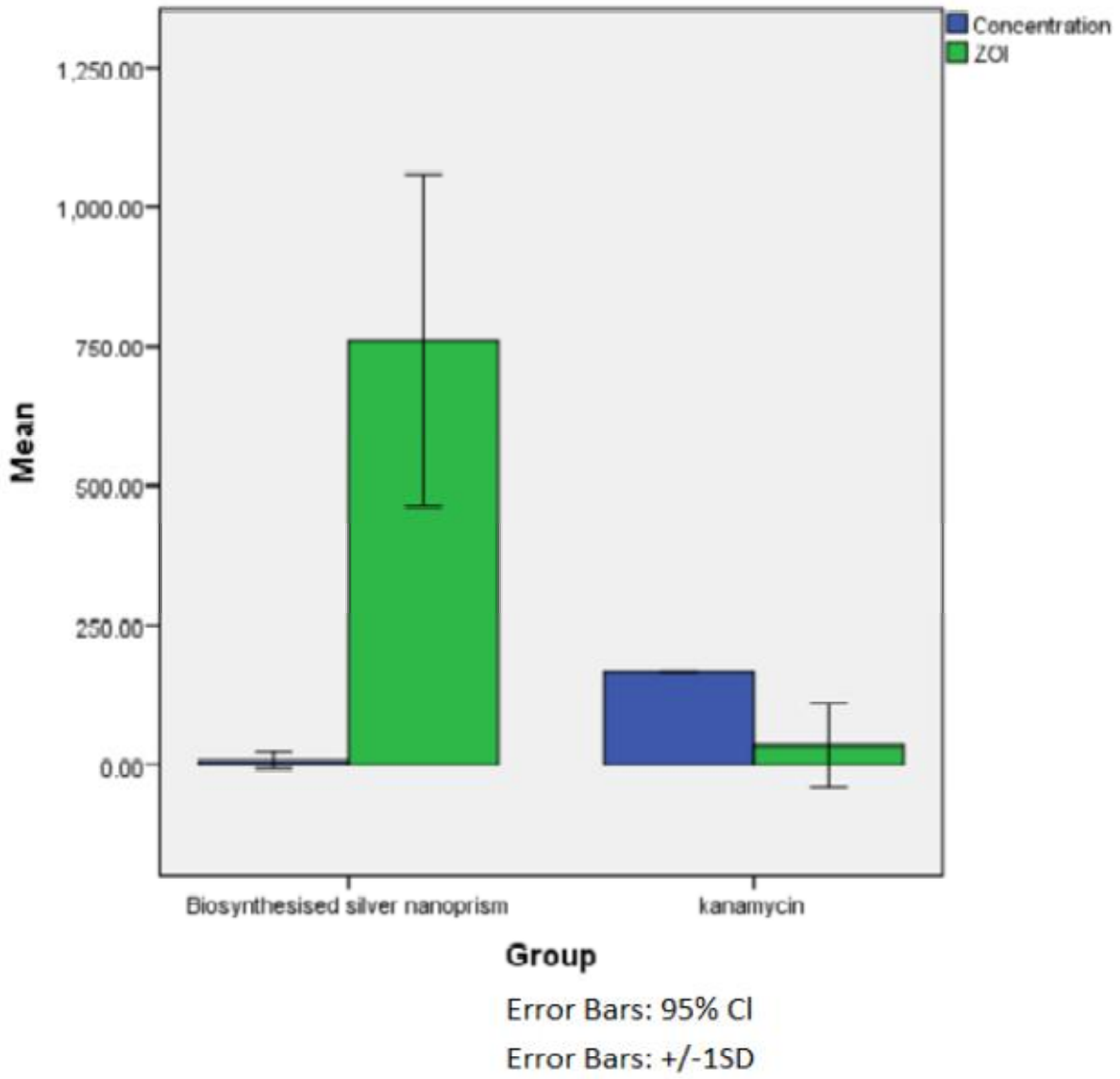

Fig. 5. Antibacterial test compared with kanamycin and biosynthesized silver nanoprism. The zone of inhibition is higher even at lower concentration of biosynthesized silver nanoprism. The error bar is fixed as 95%CI.

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