FORMULATION AND CHARACTERIZATION OF SILVER NANOPARTICLES AND ASSESSMENT OF THEIR MEDICINAL APPLICATION

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***Abstract*-The aim of the present study is to formulate and evaluate antibacterial drug loaded silver nanoparticles for synergistic activity. It involves formulate and evaluate silver nanoparticles, Conjugation of silver nanoparticles with some antibacterial drugs and increase the drug antibacterial activity by Nano sizing the drug particles. To reduce the dose of the drug and eventually the adverse side effects. To increase the activity of antibacterial drug against different microorganism. To study the in-vitro diffusion study of optimized formulation. To find out the effect of antibacterial drug loaded silver nanoparticles on different bacterial culture by using animal model. Further evaluation and characterization of these batches of nanoparticles for the particle size, Polydispersity index, zeta potential & % entrapment efficiency. The results observed for particle size AgNPs were found to be below 100 nm. The zeta potential of batch was found in range of –6.80± 1.50 mV. Typically a minimum zeta potential of greater than -30 mV is considered acceptable and indicative of good stability.. optimized batches were used to perform the antimicrobial activity of silver nanoparticles were observed with increased effect than single drug Minimum inhibitory concentration and bacterial sensitivity of drug with synergistic activity were determined by using well diffusion method. In which Silver nanoparticles showed the MIC at concentration of 0.003% respectively.**

Keywords: **Nanoparticles, silver nanoparticles, diffusion method**

1. Introduction:

Nanotechnology is a rapidly expanding field, encompassing the development of man-made materials in the nanometer size range, Nanoparticles can be defined as any objects ranging in size from 1-100 nm. Presently, different metallic nanomaterials are being produced such as copper, zinc, titanium, magnesium, gold, alginate and silver. Tuning size and shape of nanoparticles alter their properties and offer huge opportunities for surprising discoveries.Nanoparticles can be classified into different types according to their size, morphology, physical and chemical properties.

2. Materials and methodology:

2.1 The following drugs, polymers, excipients and chemicals were used for the formulation and characterization of drug loaded nanoparticles and topical preparation.

Table 1 List of drug and excipient

Sr. No.	Contents	Materials	Sources
1.	Excipients	Silver Nitrate	Loba Chemie Pvt. Ltd, Mumbai
		Sodium Borohydride	Loba Chemie Pvt. Ltd, Mumbai
		Polyvinyl Pyrrolidone	Himedia Pvt. Ltd. Mumbai
		Polyvinyl Alcohol	SRL Chemical Pvt. Ltd,
2.	Chemicals	Polyethylene Glycol Dimethyl Formamide	MumbaiLoba Chemie Pvt. Ltd, Mumbai
		Potassium Dihydrogen Phosphate,	Loba Chemie Pvt. Ltd, Mumbai

		Bee's Wax, Cetosteryl Alcohol, White Soft Paraffin	S.D. Fine-Chem Limited, Mumbai S.D. Fine-Chem Limited,
		Liquid Paraffin (Light), Propylene Glycol, Cetomacrogol 1000	Loba Chemie Pvt. Ltd, Mumbai SRL Chemical Pvt. Ltd, Mumbai
3.	Preservatives	Methyl Paraben, Propyl Paraben	Himedia Pvt. Ltd. Mumbai

Table 2 List of Instruments

Sr. No.	Instruments Name	Name of Manufacturer
1.	UV-Visible Spectrophotometer	Shimadzu, Japan
2.	Particle Size Analyzer	Malvern Zeta Seizer 2000, Malvern.
3.	Electronic Balance	Shimadzu, Japan
4.	Digital pH-Meter	Elico Pvt. Ltd., India
5.	Ultrasonicator	PCI, India
6.	Lyophilizer (Freeze Dryer)	Mac ®, Macro Scientific Works, Delhi
7.	Fourier Transfer Infrared Spectrophotometer	Alpha-E Bruker, Germany
8.	X-Ray Diffractometer	Bruker Axs D8 Advance, Germany
9.	Differential Scanning Calorimetry	Mettler DSC, Mettler Toledo, Switzerland
10.	Hot Air Oven	Spectra Equipment's, Hyderabad
11.	Brook Filed Viscometer	Fungi Lab.
12.	Magnetic Stirrer	Remi Instruments Ltd., Mumbai
13.	High Speed Homogenizer	Panda, Gea Nitro Soave, Italy
14.	Digital Melting Point Apparatus	EO730 Equiptronics,
15.	Milli-Q Water	Direct Ultra-Tuvf5, Bio-Age and Services
16.	Vortex Mixer	Icon Instruments Company, Delhi

17.	Cooling Centrifuge	Remi Instruments, Mumbai, India
18.	Orbital Shaker	Remi, Ai-7781, India
19.	Autoclave	York Scientific Industries Pvt Ltd., Sahibabad

3. EXPERIMENTAL WORK, RESULTS AND DISCUSSION PART-I

3.1 Materials

Silver Nitrate was obtained from Loba chemise Pvt. Ltd., Sodium Borohydride Polyvinyl Pyrrolidone (PVP), Sodium Citrate, Polyvinyl alcohol (PVA) was obtained from Loba chemise Pvt. Ltd. Water required for chemical process was obtain from a Milipore synergy system (Milipore, USA).

Experimental Results:

Table 3 Organoleptic properties of Silver Nitrate

Sr. No.	Property	Result
1.	Colour	white crystalline solid
2.	Odour	Odorless
3.	Nature	Crystalline

Table 4 Solubility of Silver Nitrate

Sr. No.	Organic solvent	Solubility of Silver Nitrate
1.	Ethanol	Soluble
2.	Acetone	Soluble
3.	Distilled Water	Very soluble

5.7.2.4 Determination of Acidity and Alkanity

Acidity and alkanity of Silver Nitrate determined by dissolving 0.4 g of Silver Nitrate in 10 mL of water. From this to a 2-mL portion added bromocresol green. The colour of the solution is blue. To another 2-mL portion of the test solution phenol red was added. The colour of the solution turns to yellow Figure 5.4 which gives confirmation of Silver Nitrate.

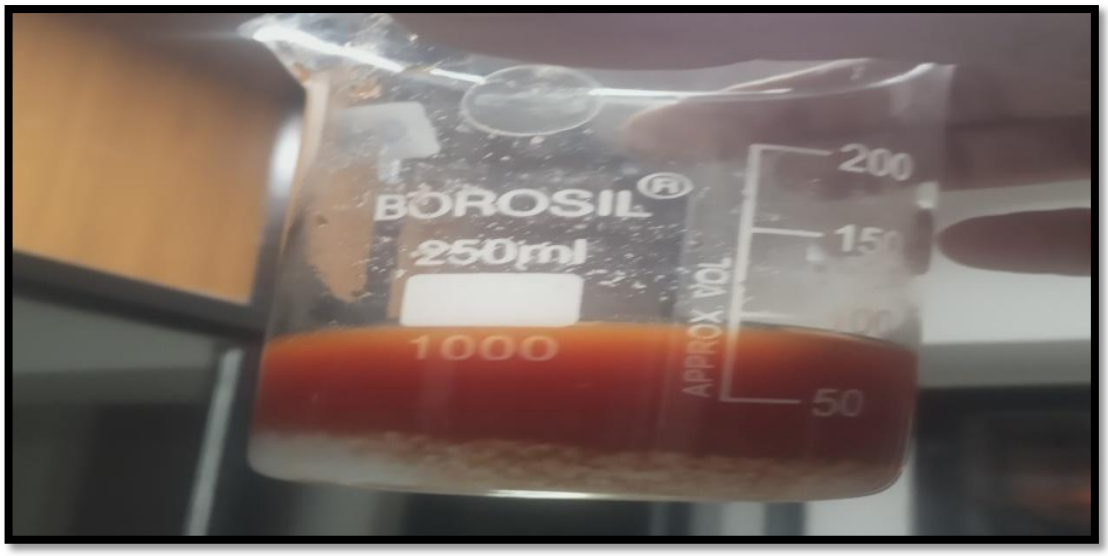

Figure 1 Acidity and alkanity test of Silver Nitrate

Ultraviolet (UV) visible Spectroscopy

5.7.3.1 Determination of lambda max (λ_{max}) of Silver Nitrate in water

The Silver Nitrate shows maximum absorbance at λ max 345 nm as shown in Figure 5.5.

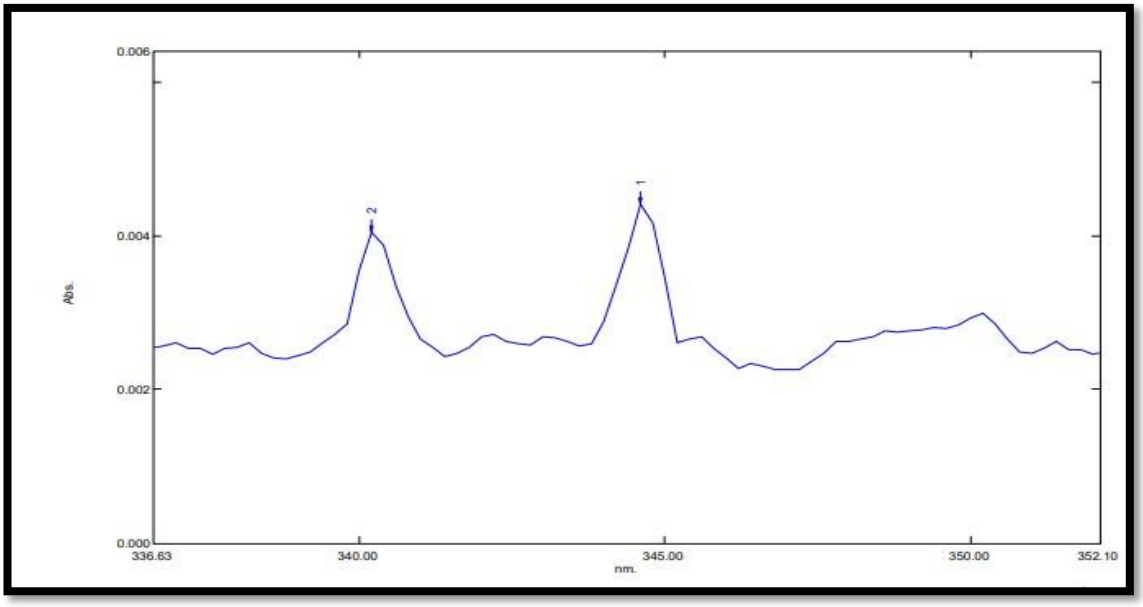

Figure 1 UV spectrum of Silver Nitrate in water

Table 5 Interpretation of FTIR spectrum of Silver Nitrate & Sodium Borohydride

Functional group	**Reported frequencies(cm^{-1})**	**Observed frequencies(cm^{-1})**
N=O	1600-1500	1554
B-H	1100-1200	1108,1186
B-H	2200-2300	2208
C-O	2200-2300	2283

Formulation of Silver Nanoparticles by chemical reduction method

The color changes as per the addition of Silver Nitrate into the ice cold reducing agent it shows the reduction occurs and it forms the Silver Nanoparticles.

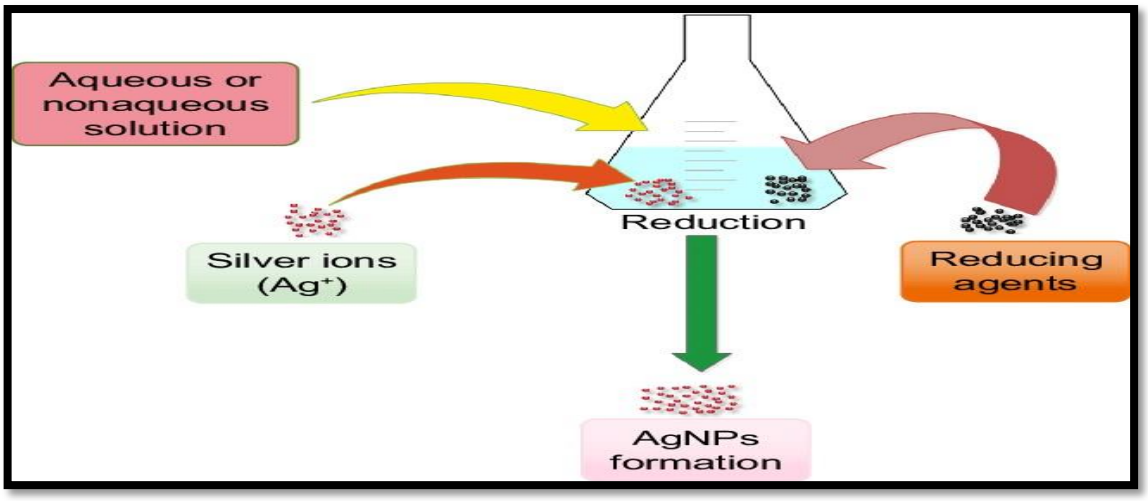

Figure 3 Preparations of Silver Nanoparticles

ACKNOWLEDGMENT: -

The Authors would like to thanks Mr.Tushar Akhare, Shree Sainath College of Pharmacy, Nagpur, for providing necessary laboratory facilities, support and enthusiasm to complete this work. I additionally conveys| God for complete my work with success and that I take privilege to sincerely thank my academician for his extreme support and steerage all throughout my work.

CONFLICT OF INTEREST: -

Compliance with moral Standards: The authors declare that they need no conflict of interest.

REFERENCES:

1. Alanis, A.J., 2005. Resistance to antibiotics: are we in the post-antibiotic era. Archives of medical research, 36(6), pp.697-705.
2. Anselmo, A.C. and Mitragotri, S., 2014. Cell-mediated delivery of nanoparticles: taking advantage of circulatory cells to target nanoparticles. Journal of controlled release, 190, pp.531-541.
3. Aslam, B., Wang, W., Arshad, M.I., Khurshid, M., Muzammil, S., Rasool, M.H., Nisar, M.A., Alvi, R.F., Aslam, M.A., Qamar, M.U. and Salamat, M.K.F., 2018. Antibiotic resistance: a rundown of a global crisis. Infection and drug resistance, 11, p.1645.
4. Banerjee, D. and Stableforth, D., 2000. The treatment of respiratory Pseudomonas infection in cystic fibrosis. Drugs, 60(5), pp.1053-1064.
5. Barillo, D.J. and Marx, D.E., 2014. Silver in medicine: A brief history BC 335 to present. Burns, 40, pp.S3-S8.
6. Beyene, H.D., Werkneh, A.A., Bezabh, H.K. and Ambaye, T.G., 2017. Synthesis paradigm and applications of silver nanoparticles (AgNPs), a review. Sustainable materials and technologies, 13, pp.18-23.
7. Blazquez, J., Oliver, A. and Gomez-Gomez, J.M., 2002. Mutation and evolution of antibiotic resistance: antibiotics as promoters of antibiotic resistance. Current drug targets, 3(4), pp.345-349. 8. Boucher, H.W. and Corey, G.R., 2008. Epidemiology of methicillin-resistant Staphylococcus aureus. Clinical infectious diseases, 46 pp.S344-S349.
9. Bukhari, S.Z., Ahmed, S. and Zia, N., 2011. Antimicrobial susceptibility pattern of Staphylococcus aureus on clinical isolates and efficacy of laboratory tests to diagnose MRSA: a multi-centre study. Journal of Ayub Medical College Abbottabad, 23(1), pp.139-142.
10. Burrell, R.E., 2003. A scientific perspective on the use of topical silver preparations. Ostomy Wound Management, 49(5; SUPP), pp.19-24.
11. Capita, R. and Alonso-Calleja, C., 2013. Antibiotic-resistant bacteria: a challenge for the food industry. Critical reviews in food science and nutrition, 53(1), pp.11- 48.
12. Chakrabarti, S., Chattopadhyay, P., Islam, J., Ray, S., Raju, P.S. and Mazumder, B., 2019. Aspects of nanomaterials in wound healing. Current drug delivery, 16(1),