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ANTI-MICROBIAL ACTIVITY OF SILVER NANO-PARTICLES SYNTHESISED USING HERBAL FORMULATION

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ABSTRACT

Aim: To assess the antimicrobial property, synthesis and characterization of Silver nano particles usingherbal formulations of lycopene, raspberry and green tea. **Materials and methods:** the synthesis of nanoparticles was done using lycopene (25%), raspberry (10%) and green tea (95% polyphenols) and 0.016 gms of silver nano-particles, characterization was done using transmission electron microscope (Zeiss 120 TEM), anti-microbial test using disc diffusion method in the most common 4 oral commensals. **Results:** The present assay shows that the highest area of inhibition is seen in *C.albicans* and the lowest inhibition seen in *Staphylococcus aureus* incomparison with the standard antibiotics seen, the shape of the nano particle obtained was spherical. **Conclusion:** From the above results it can be concluded that the combination of silver nano particles infused media has a better anti-microbial property, especially as an anti-fungal.

Keywords: Lycopene, nanoparticle, antimicrobial

INTRODUCTION

Silver nano-particle has been well known as an effective anti-microbial material and has no side effects. This is due to their size and permeability into the cell membrane which can alter the structure of cell membrane and finally resulting the death of cell **[1-3]**. The effective of silver nanoparticles against gram-negative food borne bacteria that is *Escherichia coli, Salmonella enteritidis* and *Klebsiella pneumoneae* including the shorter period of killing or destruction activity **[4-6]**. The assessment of the antimicrobial property of silver-nanoparticles can be done only after the evaluation of its size, shape, surface area and the distribution, they have been used in the fields of diagnosis, anti-cancer management **[7-9]**. The synthesis of silver nanoparticles are commonly done using chemical method, other methods include physical and biological methods, chemical method is cost-effective and has more yield of particles **[10-12]**. The use of lycopene is because of its high anti-oxidant and microbial activity along with the presence of raspberry and green tea is an highly solvable and effective compound against most common oral commensals such as *E.coli, S.aureus, S.mutans*, with the presence of silver nanoparticle, the solubility and permeability is increased thus increasing its effective as an disinfection and the sterilizing property **[13-15]**. The epicatechin gallate present in the green tea has a moderate potent of microbial activity inhibition, among the oral commensals the *S.aureus* and the beta lactam microbes are the most susceptible **[17]**. Raspberry extracts have been shown to be effective against the about 16 types of microbes including the most common oral commensal *S.aureus*, and has strong inhibitory activity

MATERIALS AND METHODS

Synthesis and characterization of silver nanoparticles infused herbal extract:

Materials used includes raspberry (25%), lycopene (10%), green tea (95% polyphenols) and 0.016 gm silver nano particles, concentration of extract by boiling at 50 degree Celsius for 30min, centrifuging is done at 8000RPM for 10 mins using refrigerated Centrifuging method, finally separation of concentrated extracts, characterization of silver nano particles infused herbal formulation was done using Transmission electron microscope (Zeiss libra 120 TEM) **(Figure 3)**.

Anti-Microbial testing:

The antibiotic testing followed in the current study is agar diffusion method or kirby-bauer method. Four petri dishes containing agar

media are then subjected to the application of 4 most common oral commensals such as *S.aureus, E.faecalis, C.albicans, S.mutans*. The process by which these organisms are taken is using a sterile swab from the respective broth culture in an aseptic method, they are subjected into the wells containing the antibiotics (silver nanoparticles infused lycopene, raspberry, green tea) in the quantity of 25µL, 50µL and 100µL along with a control antibiotic (such as amoxicillin) in the four respective petri dishes. An area of demarcation is formed around the wells where the antibiotics are subjected to. The extent from the edge of the wells to the area of demarcation is measured which is known as the zone of inhibition, this indicates the effective inhibition or stoppage of bacterial growth by the antimicrobial that is subjected **(Figure 1)**.

RESULTS

The results of this study show that the combination of lycopene, raspberry, green tea and silver nanoparticle formulation have better antimicrobial efficiency ,the antimicrobial efficiency of the herbal formulation when compared with control antibiotic, had good levels of effective zone of inhibition. The present assay shows that the highest area of inhibition is seen in *C.albicans* with an area of 35mm in 100µlconcentration and the lowest inhibition seen in *Staphylococcus aureus* (9mm at 25µl concentration) in comparison with the standard antibiotics seen, the shape of the nano particle obtained was spherical, with sizes differing from 4 to 50nm, AgNP's peak absorbance occurs at 490 nm with high absorbance.

DISCUSSION

Study done by Faizan *et al*., (2019) using silver nanoparticles infused *MK (Murraya koenigii)* has revealed the inhibition zone of diameters 21mm and 19 mm against *MRSA (methicillin resistant Staphylococcus aureus)*, but the current study the *S.aureus* variant has the lowest inhibition percentage of 9mm in the dosage of 25µl and the highest being 25 mm at concentration of 100 µl **[18-20] (Figure 2)**, while other studies by Stefan *et al* (2020) has shown the anti-microbial activity of specific oral commensals such as *P.gingivalis* and *A.naeslundii*, but the highest inhibitory zone in *P.gingivalis* (3 mm) but while in the current study the minimum inhibitory concentration was 9 mm which is against *S.aureus* , while in the respected article the inhibition area was Nil against *S.aureus* which proves the effectiveness of the current herbal formulation infused with nanoparticles **[21, 22]**. Studies showing the effectiveness of

green by Wanda.C (2014) has shown the inhibitory of EGCG present in green tea showing lytic activity against gram negative oral commensals, with *E.coli* being the most susceptible to destruction , other bacteria of interest that also undergoes lysis include *H.pylori* and *S.aureus* **[22]** (**Table 1**) . Studies on Raspberry extracts by Octavio *et al* (2012) has proven the effectiveness of *S.mutans* and *P.gingivalis*, an area of inhibition at the concentration of 350 µg/ml 23.9mm, and the highest inhibition concentration of 28.6mm seen against *P.gingivalis* species, the process of immunity by this particular black raspberry species is due to its increase strain reduction against oral bacteria especially *F.nucleatum* (showing 36mm at the dose of 1400 µg/ml), which in the present study the maximum area of inhibition of 35mm is seen against *Candida albicans* which makes the present combination the best anti-fungal , followed by 24mm inhibition against *Streptococcus mutans* **[23-25]**.

Table 1: represents the comparison of zone of inhibition between antibiotic and lycopene, raspberry, green tea and silver nano-particles formulation

Species	Control Antibiotic- Zone of Inhibition	Herbal Formulation-Zone of Inhibition
Staphylococcus Aureus	12mm	23mm
Streptococcus mutans	22mm	36mm
Enterococcus faecalis	20mm	38mm
Candida albicans	35mm	20mm

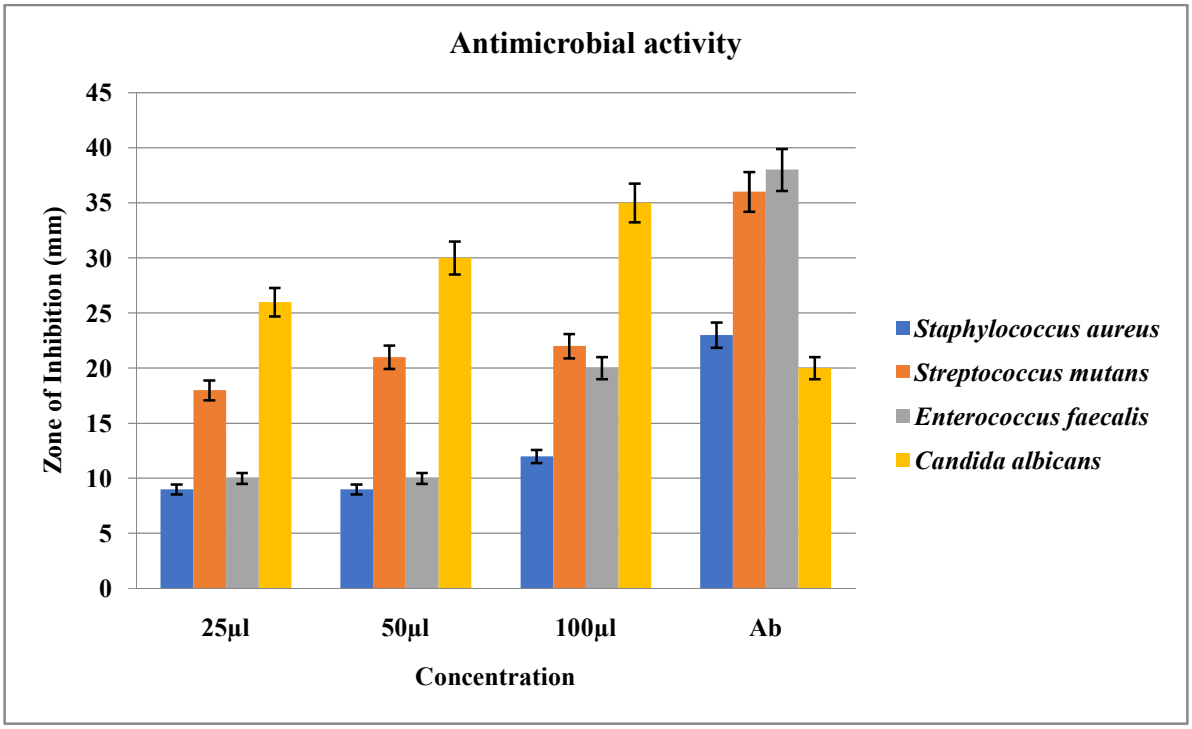

Figure 1: Anti-microbial zone of inhibition seen among the various

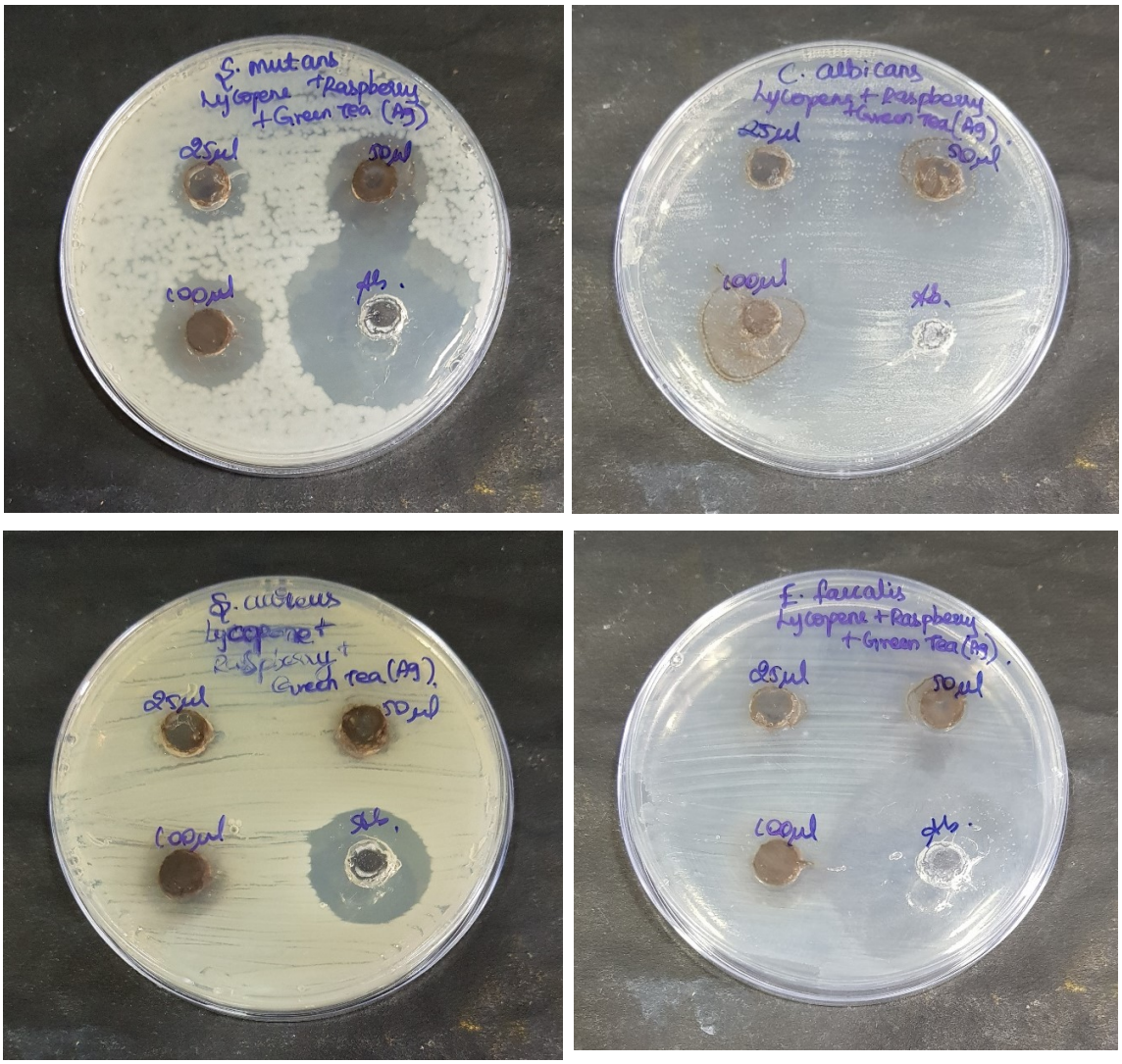

Figure 2: shows agar media containing various microbial compounds and the respective area of inhibition

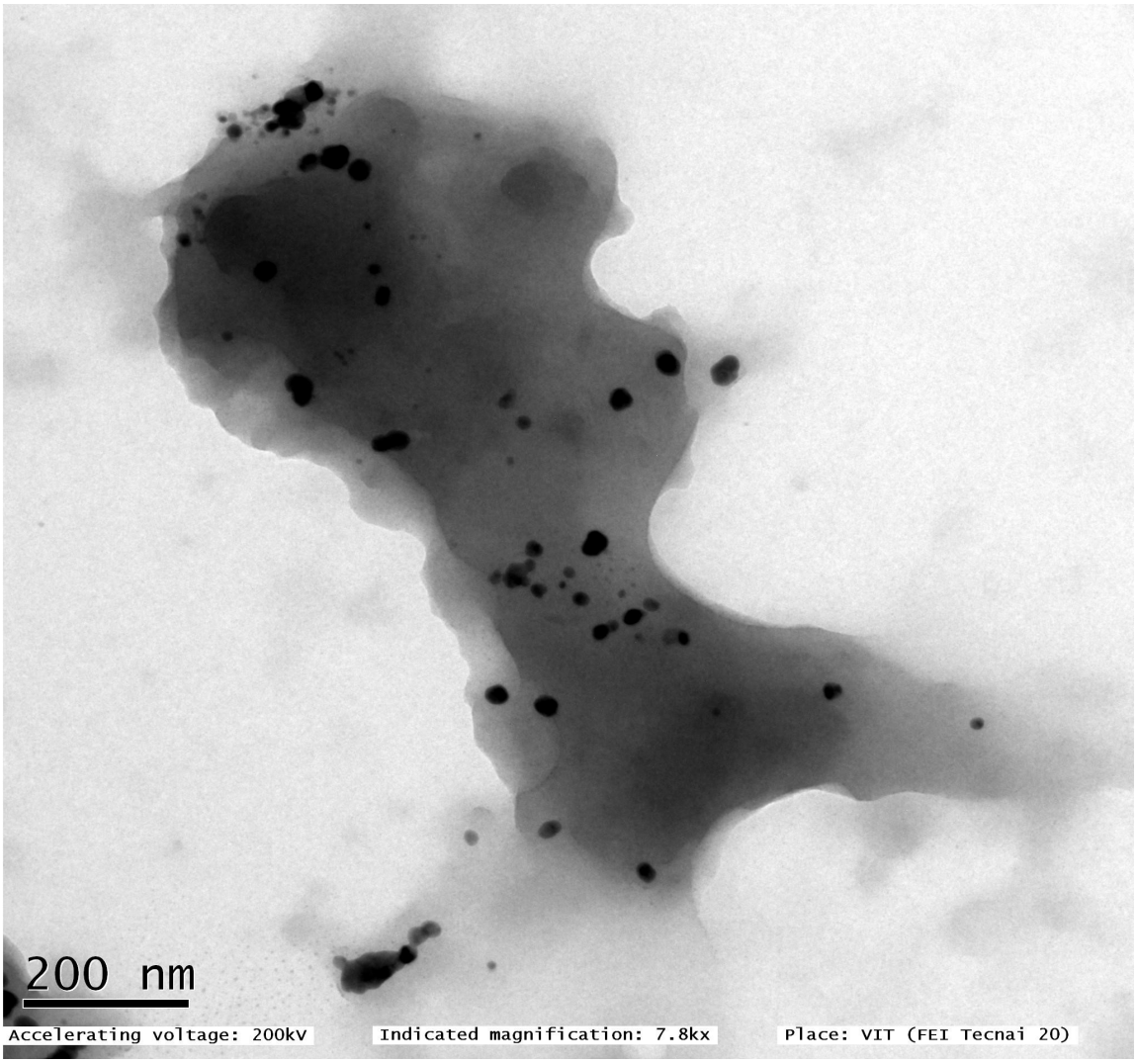

Figure 3: Characterization of nano-particles done under Transmission electron microscope (TEM) at 200nm

CONCLUSION

The present study concluded that lycopene, raspberry, green tea and silver nanoparticles combination has a significant anti-microbial property, among the 4 most common oral commensals tested, based on the microbial inhibition, it is highly effective anti-fungal and anti-bacterial formulation.

REFERENCES

[1] Ranjbar A, Ranjbar E. Antimicrobial Property of Lycopene Oleoresin on some Food Pathogens Running Head: Lycopene oleoresin antibacterial potent. پژوهشهایعلوموصنایعغذاییایران, 2016 2016.

[2] Umar M, Zubairu A, Hamisu HS, Mohammed IB, Oko JO, Abdulkarim IM, *et al*. Evaluation of Phytochemical and in vitro Antimicrobial Effects of *Solanum*

lycopersicum Linn. (Tomato) on Oral Thrush and Human Cariogenic Pathogens. Journal of Advances in Medical and Pharmaceutical Sciences 2016: 1–9.

[3] Ryan T, Wilkinson JM, Cavanagh HM. Antibacterial activity of raspberry cordial in vitro. Research in veterinary science. 2001 Dec 1; 71(3): 155-9..

[4] Takeoka GR, Dao L, Flessa S, Gillespie DM, Jewell WT, Huebner B, *et al*. Processing effects on lycopene content and antioxidant activity of tomatoes. J Agric Food Chem 2001; 49: 3713–7.

[5] Santos RD, Pimenta-Freire G, Figueiredo FJB, Dias-Souza MV. Interference of flavonoids and carotenoids on the antimicrobial activity of some drugs against clinical isolates of Pseudomonas aeruginosa. Food Chem Toxicol., 2016; 23.

[6] Sujatha J, Rajeshkumar S, Lakshmi T. Antidermatophytic, the anticancer and antioxidant activity of Cassia alata ethanolic extract and its phytochemical analysis. International Journal of Research in Pharmaceutical Sciences 2019; 10: 838–45.

[7] Park CH, Yeo HJ, Baskar TB, Park YE, Park JS, Lee SY, et al. In Vitro Antioxidant and Antimicrobial Properties of Flower, Leaf, and Stem Extracts of Korean Mint. Antioxidants (Basel) 2019; 8. https://doi.org/10.3390/antiox8030075.

[8] Gupta S, Jawanda MK, Arora V, Mehta N, Yadav V. Role of Lycopene in Preventing Oral Diseases as a Nonsurgical Aid of Treatment. Int J Prev Med 2015; 6: 70.

[9] Pavunraj M, Rajeshkumar S, Bhuvana L, Babujanarthanam R. Preparation of Cassia auriculata plant extracts using different solvents and its antibacterial and antifungal activity against clinical pathogens. Drug Invention Today 2019; 11.

[10] Bakshi HA, Mishra V, Satija S, Mehta M, Hakkim FL, Kesharwani P, et al. Dynamics of Prolyl Hydroxylases Levels During Disease Progression in Experimental Colitis. Inflammation 2019; 42: 2032–6.

[11] Mahato B, Prodhan C, Mandal S, Dutta A, Kumar P, Deb T, *et al*. Evaluation of efficacy of curcumin along with lycopene and piperine in

the management of oral submucous fibrosis. Contemp Clin Dent 2019; 10: 531.

[12] Ponnanikajamideen M, Rajeshkumar S, Vanaja M, Annadurai G. In Vivo Type 2 Diabetes and Wound-Healing Effects of Antioxidant Gold Nanoparticles Synthesized Using the Insulin Plant *Chamaecostus cuspidatus* in Albino Rats. Canadian Journal of Diabetes 2019; 43: 82–9.e6.

[13] Lakshmi T, Renukadevi BS, Senthilkumar S, Haribalan P, Parameshwari R, Vijayaraghavan R, *et al*. Seed and bark extracts of Acacia catechu protects liver from acetaminophen induced hepatotoxicity by modulating oxidative stress, antioxidant enzymes and liver function enzymes in Wistar rat model. Biomedicine & Pharmacotherapy 2018; 108: 838–44. https://doi.org/10.1016/j.biopha.2018.08.077.

[14] Mehta M, Dhanjal DS, Paudel KR, Singh B, Gupta G, Rajeshkumar S, et al. Cellular signalling pathways mediating the pathogenesis of chronic inflammatory respiratory diseases: an update. Inflammopharmacology 2020; 28: 795–817. https://doi.org/10.1007/s10787-020-00698-3.

[15] Sujatha J, Asokan S, Rajeshkumar S. Phytochemical analysis and antioxidant activity of chloroform extract of Cassis alata. Research Journal of Pharmacy and Technology 2018; 11: 439–44.

[16] Thangavelu L, Balusamy SR, Shanmugam R, Sivanesan S, Devaraj E, Rajagopalan V, et al. Evaluation of the sub-acute toxicity of Acacia catechu Willd seed extract in a Wistar albino rat model. Regul Toxicol Pharmacol 2020; 113: 104640.

[17] Gopal J, Muthu M, Paul D, Kim DH, Chun S. Bactericidal activity of green tea extracts: the importance of catechin containing nano particles. Scientific Reports. 2016 Jan 28; 6(1): 1-4.

[18] Aman S, Naim A, Siddiqi R, Naz S. Antimicrobial polyphenols from small tropical fruits, tea and spice oilseeds. Food Science and Technology International. 2014 Jun;

20(4): 241-51.

[19] Bandyopadhyay D, Chatterjee TK, Dasgupta A, Lourduraja J, Dastidar SG. In vitro and in vivo antimicrobial action of tea: the commonest beverage of Asia. Biological and Pharmaceutical Bulletin. 2005; 28(11): 2125-7.

[20] Bokan A, Vukmirović S, Medić D. The antibacterial effect of the combination of red raspberry concentrate and antibiotics on Staphylococcus aureus. In BMC Proceedings 2015 Dec (Vol. 9, No. 7, pp. 1-1). BioMed Central.

[21] Alcaraz LE, Blanco SE, Puig ON, Tomas F, Ferretti FH. Antibacterial activity of flavonoids against methicillin-resistant *Staphylococcus aureus* strains. Journal of theoretical Biology. 2000 Jul 21; 205(2): 231-40.

[22] Aritonang HF, Koleangan H, Wuntu AD. 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 Jul 1; 2019.

[23] Feng A, Wu S, Chen S, Zhang H, Shao W, Xiao Z. Synthesis of silver nanoparticles with tunable morphologies via a reverse nano-emulsion route. Materials Transactions. 2013 Jul 1; 54(7): 1145-8.

[24] Asha S, Thirunavukkarasu P, Rajeshkumar S. Green synthesis of silver nanoparticles using mirabilis jalapa aqueous extract and their antibacterial activity against respective microorganisms. Research Journal of Pharmacy and Technology. 2017; 10(3): 811-7.

[25] Vignesh S, Anitha R, Kumar SR, Lakshmi T. Evaluation of the antimicrobial activity of cumin oil mediated silver nanoparticles on oral microbes. Research Journal of Pharmacy and Technology. 2019; 12(8): 3709-12.