Chapter 6

Summary and conclusion

• Isolation of marine biofilm forming bacteria from marine biofilms and screening of bacterial isolates for biofilm forming ability was carried out through microtiter plate assay.

• Five marine biofilm forming bacteria were selected based on their biofilm forming efficiency and identified through 16S rDNA sequencing as *Pseudomonas otitidis* strain NV1 [KF574079], *Pseudomonas aeruginosa* strain NV2 [KF574080], *Enterobacter cloacae* strain NV3 [KF574081], *Microbacterium* sp. NV4 [KF574082] and *Staphylococcus hominis* strain NV5 [KF574083].

• Synthesis of silver (AgNPs) and zinc oxide (ZnO-NPs) nanoparticles were carried out using chemical and biological methods. The synthesized nanoparticles were confirmed using UV spectroscopic analysis, the size and crystallinity of the nanoparticles were confirmed using XRD.

• Antimicrofouling activity of biosynthesized and chemically synthesized AgNPs and ZnO-NPs was studied and based on the antimicrofouling activity biosynthesized nanoparticles were selected for further studies.

• TEOS sol-gels were synthesized and the optimum coating conditions were found to be temperature - 70 °C, volume -200 µl and time – 72 h.

• Optimization of various process parameters to enhance the biosynthesis of AgNPs and ZnONPs was carried out through RSM based on 4-level BBD.

• The design for the optimization of AgNPs synthesis consisted of 29 runs, maximum AgNP synthesis was observed at pH 7, time 15 h, ratio of leaf extract and AgNO3 1:3 and temperature 35 °C.

• The design for ZnO-NP consisted of 17 runs, maximum ZnO-NP yield was obtained at Concentration of fruit extract 50 %, temperature 120 °C and time 6 h

• Biosynthesized nanoparticles were characterized through various instrumentation techniques viz. AFM, FTIR, TEM, EDAX, SAED, Zeta potential and Particle sizer.
• Mechanism of action of biosynthesized AgNPs and ZnO-NPs against marine biofilm forming bacteria was investigated.
• The biosynthesized AgNPs and ZnO-NPs were found to induce the leakage of membrane proteins and inhibit the EPS production in the marine biofilm forming bacterial isolates.
• Antimacrofouling activity of the nanoparticles was studied against marine macrofouling organisms. The results indicated that both the nanoparticles could inhibit the attachment of molluscs (Patella sp. and Trochus sp.) and showed significant percentage of mortality against crustacean fouling larvae (Artemia salina).

Thus the present work gives scope for the possible development of formulations containing AgNPs and ZnO-NPs as effective antifouling agents that could prevent the adhesion of micro and macrofoulers thereby preventing marine biofouling.