National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Chitosan-based Bioactive Nanofibrous Hemostatic Agent for Emergency Care
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Venue	: Seminar Room, BM Department
Date and Time	: 15 Apr 2025 (10:00 AM)

Abstract : Bleeding causes &sim5.8 million deaths globally half of the patients die if rapid hemostasis is not achieved. In India, road traffic injuries are a significant concern, which causes 40% of deaths due to hemorrhage, and there is a rise of 2.4% every year. Commercially available hemostatic agents require at least 1-2 minutes for blood clotting, and most are either difficult to apply, expensive, or produce exothermic reactions upon contact with blood to cause adverse reactions. Our study developed a novel self-assembly-based facile method to fabricate chitosan-casein/gelatin nanofibers through polyelectrolyte complex (PEC) formation for rapid hemostasis.

Further, the nanofiber formation and characterization showed that electrostatic interaction between the charged amine and negatively charged phosphate, carboxyl groups could lead to < 50 nm diameter nanofibers at pH of 8.0±0.1 and 10 min sonication. Nanofibrous PECs were allowed to rapidly clot within 10 seconds in both *in vitro* and *in vivo* by promoting rapid blood absorption and platelet activation, which were nine-fold better than Celox&trade. The chitosan-casein PECs could also be developed as a microporous hemostatic sponge (CC30G) with a porosity of 73.00±4.74%, a pore diameter of 42.66±5.33 µm, and rapid water absorption capacity (1165±55%). The bioactivity of nanofibrous PECs could be improved by incorporating ZnO and AG-NPs (Nanoparticles) without compromising their hemostatic efficiency or biocompatibility. Further, nanofibrous PEC with nanoparticles had excellent bioactivity in promoting cellular/tissue metabolic enzymes involved in skin regeneration and could enhance platelet aggregation and activation and strong bactericidal activity.

Taken together, chitosan-casein/gelatin nanofibrous PEC could rapidly clot the blood within 10 seconds under in vitro conditions by promoting platelet activation and aggregation, rapid absorption of plasma, and activation of the extrinsic coagulation pathway. It could also clot blood within 10 s in the rat femoral artery puncture model and within 25 s in the rabbit ear artery model. The PEC was bioactive, bactericidal, hemocompatible, biocompatible, non-toxic, non-immunogenic, and safe for animal models. The chitosan-based PECs could also be developed as hemostatic sponges for skin cuts and lacerations.