**ABSTRACT**

Development of highly improved or reinforced Graphene oxide nanosheets were synthesized by converting it into a whole green GO nanofiber material and by infusing the aqueous seed extracts of *Sesamum indicum* (SI), along with the fiber generation process of GO. The synthesized GO nanofibers (NF) and GO/SI NF were characterized for structural, morphological, elemental and functional group analysis. The antimicrobial and biocompatible nature of GO/SI NF was evaluated in comparison with GO NF. The results showed the non-toxic nature of both the nanofibers (GO NF and GO/SI NF) on gram-negative bacteria (*Klebsiella oxytoca*) and gram-positive bacteria (*Staphylococcus aureus*). Both the nanofibers were hemo-/biocompatible toward human red blood cells and human epithelial cell lines (TH 1); however, the hemo-/biocompatibility was further increased after the addition of SI into GO NF, and therefore, GO/SI NF can be a potent green nanofiber material for the biomedical applications.