At present, the environmentally benign and economically efficient green route has received a considerable attention of the researchers for the swift synthesis of highly stable silver nanoparticles (AgNPs) and gold nanoparticles (AuNPs) due to their growing need in several fields; such as catalysis, biosensing, antimicrobial, wound healing, medicine, optoelectronics, etc. These AgNPs and AuNPs are synthesized by several routes like physical, chemical, and biological. The need of sophisticated instrumentation of high initial cost and hazardous reducing agents has limited the applicability of these routes as an eco-friendly and economically efficient route for the synthesis of AgNPs and AuNPs.

Green route, the eco-friendly and cost-effective approach for the synthesis AgNPs and AuNPs has emerged out to overcome the problems related to the physical and chemical route. Green synthesis of AgNPs is reported to be clean, nontoxic, cost-effective and environmentally acceptable. It has eliminated the use of high pressure, temperature and hazardous chemicals and additional capping agent. The green synthesis is performed via a microbial route or herbal route. The microbial route involves the use of different microorganisms such as bacteria, fungi, algae, yeast, and actinomycetes whereas the herbal route is accomplished using plants. The plant extracts are more advantageous over other biological systems because of simple, user-friendly and more economical which requires less time and eliminates the need of culture, aseptic condition, and maintenance. The plant extracts also act as a stabilizing agent and deter the aggregation of the nanoparticles. Hence, currently, it has been used most extensively as a reducing agent for the synthesis of AgNPs and AuNPs as it contains various phytochemicals which act as reductants. The excessive extraction of these valuable plants may threaten the ecosystem. Therefore, the weed plants can be a better alternative rather using ecologically important plants. Due to the inhabitants of the stress conditions, the weed plants are the chief source of secondary metabolites such as terpenoids, flavonoids, phenol derivatives, plant enzymes (hydrogenases, reductases, quinones), etc. which act a potential reducing and stabilizing agent. In the present study, on the basis of previously reported phytochemicals study, two weed plants; *Xanthium strumarium* and *Croton bonplandianum* were selected for the synthesis of AgNPs and AuNPs.

Although, the green synthesis of AgNPs and AuNPs using plant extracts is more economical and eco-friendly than other biological routes, but still the consumption of long time duration and energy while heating and stirring are its huge limitation. Therefore, it is needed to be modified with energy and time efficient route. Currently, the plant extract mediated photoinduced synthesis are proved to be completely economic and eco-friendly route for the size-controlled synthesis of the AgNPs and AuNPs as it avoids the use of energy and time consumption. In the current investigation, the photoinduced synthesis of AgNPs and AuNPs are carried out. The various factors affecting the synthesis process of AgNPs and AuNPs such as exposure time, inoculums dose, and metal ion concentration are optimized using one parameter at a time approach. After optimization, the AgNPs and AuNPs are characterized by different analytical techniques. Further, the prepared AgNPs is investigated for various applications such as antibacterial, antileishmanial and detection of Iron (III). The AuNPs is investigated for the peroxidase-like catalytic activity for the colorimetric detection of hydrogen peroxide, and glutathione. The results obtained from the optimization, characterization and various applications confirmed that the leaf extract of *Croton bonplandianum* was more potent for the synthesis of highly stable and smaller AgNPs and AuNPs comparatively *Xanthium strumarium*. Therefore, the AgNPs and AuNPs obtained from *Croton bonplandianum* plant were further used in the preparation of nanocomposites like AgNPs-rGO-PANI and AuNPs@rGO which are further used for the electrochemical detection of hydrogen peroxide and colorimetric detection of cholesterol respectively.

Thesis organization

The present thesis includes the introduction and literature review, experimental work and their possible results which are divided into following eight chapters.

Chapter 1: The current chapter deals with the introduction and exhaustive literature review. The various types of nanomaterials, synthesis approaches of nanoparticles, an overview of AgNPs and AuNPs are briefly discussed. Since the present study aims at the green synthesis of AgNPs and AuNPs, the synthesis of AgNPs and AuNPs using bacteria, fungi, algae, actinomycetes, yeasts, and plants are discussed in detail. The current chapter also discussed the properties and application of AgNPs and AuNPs, selection of the plant source and objective of the thesis work.

Chapter 2: This Chapter includes the materials and the details of the experimental procedures like preparation of leaf extracts, confirmation and quantification of polyphenolics present in leaf extracts, synthesis of AgNPs and AuNPs, AgNPs-rGO-PANI, and AgNPs@rGO nanocomposites used in this study. This chapter also includes the different characterizing techniques and their functioning in very brief. The details of the experimental procedures of various applications of AgNPs and AuNPs are discussed in brief.

Chapter 3: This chapter deals with the photoinduced synthesis of AgNPs using aqueous leaf extract of *Xanthium strumarium* (AEX), optimization of process variables affecting the synthesis process like sunlight exposure time, AEX inoculums dose, and $AgNO_3$ concentration, and characterization of the optimized AgNPs. This chapter also discussed the antibacterial and the antileishmanial activity of the optimized AgNPs.

Chapter 4: The current chapter aimed at the synthesis of AgNPs using aqueous leaf extract of *Croton bonplandianum* (AEC) and the optimization of different parameters affecting the synthesis process like sunlight exposure time, AEC inoculums dose and $AgNO_3$ concentration. This chapter also included the characterization of the optimized AgNPs using different modern characterizing techniques. In addition to this, the present chapter also discussed the selective colorimetric detection potential of AgNPs towards the Iron (III), antibacterial and antioxidant activity.

Chapter 5: The current chapter focused on the photoinduced synthesis of AuNPs using AEX and the optimization of different process parameters affecting the synthesis of AuNPs such as sunlight exposure time, AEX inoculums dose and $HAuCl_4.xH_2O$ concentration. The characterization of the optimized AuNPs thus obtained is also given in this chapter. In addition to this, the effect of different $HAuCl_4.xH_2O$ concentration on the size and shape of AuNPs is also discussed in this chapter. The synthesized AuNPs showed the peroxidase-like catalytic activity for the detection of hydrogen peroxide (H_2O_2) which are also discussed in the current chapter.

Chapter 6: This chapter deals with the photoinduced synthesis of AuNPs using AEC where the optimization of different parameters affecting the synthesis of AuNPs such as sunlight exposure time, AEC inoculums dose and $HAuCl_4.xH_2O$ concentration were also investigated. In this chapter, the size and shape of AuNPs were also tuned using different concentrations of $HAuCl_4.xH_2O$ which were studied by TEM analysis. Thus synthesized

AuNPs also showed the peroxidase-like mimetic which was utilized for the colorimetric detection of cholesterol present in real blood samples.

Chapter 7: The current study includes the preparation of AgNPs-rGO-PANI nanocomposite and fabrication of AgNPs-rGO-PANI-GCE. Thus, the fabricated AgNPs-rGO-PANI-GCE was characterized through various electrochemical techniques and further utilized for the selective and sensitive detection of hydrogen peroxide (H_2O_2) which is discussed in this chapter. In addition to this, the interference study is also presented.

Chapter 8: This chapter discussed the fabrication of AuNPs@rGO nanocomposite using AuNPs synthesized from AEC which showed the peroxidase-like mimetic activity. The characterization of AuNPs@rGO nanocomposite through various characterizing techniques is also discussed in the current chapter. The various factors affecting the peroxidase-like activity such as pH, temperature, TMB concentration, and AuNPs@rGO amount are also discussed in this chapter. Further, this chapter also discussed the colorimetric detection of cholesterol and its selectivity towards it.

In the last, the major outcomes of every chapter are summarized which is followed by the future recommendation of the current research work. Thereafter, the references which have been cited in the entire thesis are presented.