CHAPTER - I

1. Introduction

Green chemistry is a science based on non-regulatory and economically driven approach to achieve the goals of environmental protection and sustainable development. Combining the technological progress with environmental safety is one of the key challenges of the millennium [1, 2]. In this context, the present research work describes the environmentally benign approaches for the synthesis of nanoparticles as well as their properties. The end of twentieth century witnessed a major scientific and technological development, the consequences of which are now beginning to become apparent.

Nanoscience have led to the increasing unification of different disciplines of science (physics, chemistry and biology) on the nanoscale which are based on three factors such as better understanding of the properties of matter at the atomic level, progress based on the molecular approach to the way living organisms operate and the rise of information processing. Nanotechnology is an emerging field of research and technology dealing with the fabrication and engineering of materials, structures and systems with nano-scale size at least in one dimension [3, 4]. Nanotechnology is considered as an enabling technology by which existing materials, virtually all man-made materials and systems, can acquire different properties rendering them suitable for numerous novel applications varying from structural and functional to advance in-vivo biomedical applications [5].

Biosynthesis of nanoparticles have been received considerable attention due to the growing need to develop clean, nontoxic chemicals, environmentally benign solvents and renewable materials [6, 7]. As a result, the researchers in the field of nanoparticles synthesis and
assembly have turned towards the utilization of biological system such as yeast, fungi, bacteria and plant extracts for the synthesis of biocompatible metal and metal oxide nanoparticles through high rate of nucleation and control of growth [8, 9]. Among different biological systems, plant extract mediated synthesis is not yet completely explored for various metal oxide nanoparticles. Growing resistance of microorganisms to potent antibiotics has renewed a great interest towards investigating bactericidal properties of nanoparticles as an alternative [10].

Cotton is the most significant and also the purest source of fibers of cellulose that normally occur in nature [11]. Cotton fabric is more susceptible for microorganisms than the synthetic fabrics because they are predominantly hydrophilic in nature. As a result, they are capable of holding water, oxygen and nutrients which will provide a favorable environment for bacterial growth [12]. Hence the major benefit of antimicrobial activity of metal oxide nanoparticles is studied by the functional finishing on cotton to control the onset/spread of diseases and to prevent or control the development of odour from perspiration.

The present work emphasizes the synthesis of TiO$_2$, SnO$_2$ and ZrO$_2$ nanoparticles using their respective metal salts and plant extracts of Aloe vera and Nyctanthes arbor-tristis without the aid of external precipitating agents, solvents and surfactants. Experimental data (TG/DTA, XRD, SEM, EDX, AFM, TEM, UV-Vis and FT-IR) were brought up to support the hypothesis such as crystalline phase, surface morphology and particle size of synthesized metal oxide nanoparticles. In addition, treatment of cotton fiber surface with metal oxide functional nanomaterials was carried to provide efficient antibacterial and antifungal finishing against infectious microorganisms.
References


