According to an estimate made by the United Mitochondria Disease Foundation, a child born every 15 minutes either suffers from a mitochondrial disease or will develop one by the age of five. Significant progress has been made in elucidating the central role of mitochondria in influencing the life and death of a cell. Yet, effective therapies for mitochondrial diseases remain elusive. On the other hand dietary agents consist of a wide variety of biologically active compounds that are ubiquitous in plants, many of which have been used in traditional medicines for thousands of years. Most of these compounds have a very broad range safety profile. But mere applications of naturally occurring compounds are not effective therapeutics to address mitochondrial dysfunction for their poor bioavailability. Nanocarriers including liposomes and polymeric nanoparticles overcome the resistance offered by the physiological barriers in the body and aid in efficient drug delivery to improve aqueous solubility of poorly soluble drugs and enhance bioavailability for timed release of drug molecules, and precise drug targeting. Almost from the time of their appearance as bio-applicable component in the 60’s and the demonstration of their entrapment potential, liposomal vesicles have drawn attention of researchers as potential carriers of various bioactive molecules that could be used for therapeutic applications in humans and animals. However, developmental work on liposomes has been limited for its inherent problems such as low encapsulation efficiency, rapid leakage of water-soluble drug in the presence of blood components and poor storage stability. On the other hand, polymeric nanoparticles offer some specific advantages over liposomes. For instance, nanoparticles help to increase the stability of drugs/proteins/genes and possess useful controlled release properties. The present research work has been designed to elucidate and optimise an effective drug delivery system for targeting biologically active compounds to brain and/or liver mitochondria in the pathogenesis of cerebral ischemia and reperfusion in young and old rats, arsenic induced liver and brain damage and in the prevention chemical carcinogen induced hepatic cancer. The aim of the study was a search to evaluate the efficacy of vesiculated (liposomes, nanoparticles) naturally occurring non toxic compounds against oxidative damage evoked mitochondrial damage and its possible protection mechanism in rat model.