

Polymeric self-assemblies: the emerging nanocarriers for the delivery of proteins, oligonucleotides and drugs

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The advancement of biotechnologies has resulted in a plethora of novel therapeutic agents such as proteins, peptides and oligonucleotides. The challenge faced by the biotechnology and pharmaceutical industry today is the ability to convert these therapeutic agents to efficacious medicines. These therapeutic agents are labile, large molecules with poor translocation across the bio-membranes resulting in poor bioavailability. Therefore, delivery systems that can address these challenges are urgently needed to realise the potential of these therapeutic agents. We have developed a range of amphiphilic polymers which are able to form different nano self-assemblies such as nanoparticles, vesicles and polymeric micelles. This indicates the versatility of these systems in delivering a range of therapeutic agents. The unique advantage of these nano-containers compared to the conventional solid nanoparticles is that the fabrication process did not involve the use of organic solvents and high temperature that might degrade labile therapeutic agents such as proteins. We have shown that these nano-containers can protect proteins and peptides such as insulin and calcitonin from enzymatic degradation and promote protein transport through the gastrointestinal membrane indicating the potential of these systems in oral protein delivery. The versatility of the polymer construct also enables the development of intelligent delivery systems which are pH responsive and enable the endosomal escape of synthetic small interfering RNA (siRNA) at lower pH. These systems achieved levels of reporter gene knockdown between 25 and 250-fold greater compared to the commercially available *in vitro* siRNA delivery agents. Finally, these polymeric nano-containers also exhibit extremely high solubilising capacity enables the enhancement of water solubility of hydrophobic drugs. In conclusion, these polymeric self-assemblies provide a novel platform with promising potential in the delivery of proteins, oligonucleotides and drugs.