Polymeric Nanoparticles: Smart materials for drug delivery

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Introduction

Research in nanotechnology for drug delivery systems has made great impact in pharmaceutical science (Grottkau *et al.*, 2013). Nanomedicine has emerged as active research areas of nanotechnology which has application in diagnosis, prevention and treatment of diseases (Lobatto *et al.*, 2011; Riehemann *et al.*, 2009). Over the past few decades, polymeric nanoparticles has became choice of researchers for targeted drug delivery and a lot of studies have been performed on polymeric nanoparticle system for poorly soluble drugs, genes, antibodies and peptide drugs (Kiriyama *et al.*, 2013). Biodegradable polymeric nanoparticles have been used most frequently as drug delivery vehicles because of its **easy bioavailability, controlled release, better encapsulation and less toxic properti**es (Kumari *et al.*, 2010). Natural polymers include chitosan, gelatin, sodium alginate and albumin. Synthetic polymers are PLGA, PLA, PGA. There are various methods of preparation of polymeric nanoparticles of different sizes such as ionic gelation method, precipitation method, solvent evaporation method etc.

## Methods of Preparation

1. Ionic gelation:

Calvo and co-workers developed a method for preparing hydrophilic chitosan nanoparticles by ionic gelation (Calvo *et al.*, 1997).
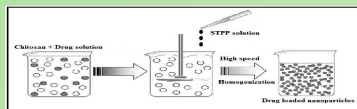
Schematic representation of preparation of polymeric nanoparticles by ionic gelation method (Nagavarma *et al.*, 2012)

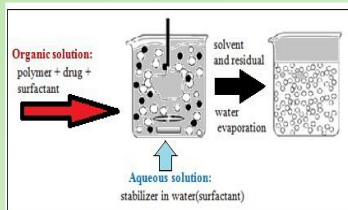| Sr. No.	Polymer	Drug	Disease	Reference
1.	Chitosan	Temoxifen citrate	Breast cancer	Patel *et al.*, 2011
2.	Chitosan	Rizatriptan benzoate	Migraine	Jadhav and Bhalerao, 2013
3.	Chitosan	Curcumin	Human Embryonic Kidney	Phuc Le *et al.*, 2013

2. Solvent evaporation:
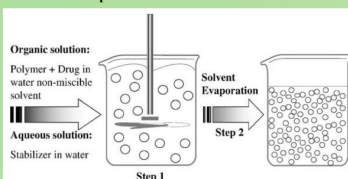
Schematic representation of the emulsification-evaporation technique (Pinto Reis *et al.*, 2006)

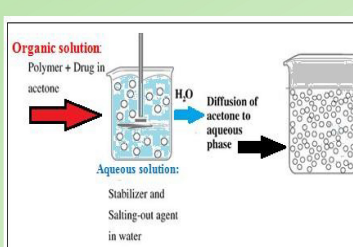| Sr. No.	Polymer	Drug	Disease	Reference
1.	Chitosan and sodium alginate	Curcumin	Cancer	Malesu *et al.*, 2011
2.	PLGA	Curcumin	Cancer	Tsai *et al.*, 2011
3.	PLA	Quercetin	Anti-oxidant	Kumari *et al.*, 2010

3. Nanoprecipitation:

Schematic diagram of preparation of polymeric nanoparticles by nanoprecipitation method (Nagavarma *et al.*, 2012)

Sr. No.	Polymer	Drug	Disease	Reference
1.	PLGA	Monensin	Malaria	Surolia *et al.*, 2012
2.	PLGA	Lycopene	Human leukemia	Gharib *et al.*, 2014
3.	Poly(lactic acid) (PLA)	Lomustine	Lung cancer	Mehrotra and Pandit, 2012

4. Salting out:

Schematic representation of salting out method for preparation of polymer nanoparticles (Nagavarma *et al.*, 2012)

Sr. No.	Polymer	Drug	Disease	Reference
1.	Gelatin	Colchicine	Breast cancer	Chandrethiya *et al.*, 2013
2.	PLGA	Clonazepam		Nah *et al.*, 1998
3.	PCL and PMMA	Triiodothyroacetic acid (Triac)	Thyroid	dos Santos *et al.*, 2012

Characterization

Sr. No.	Parameter	Technique
1.	Particle Size	Dynamic Light Scattering, X-Ray Scattering TEM, SEM and AFM
2.	Surface Charge	Zeta potential measurement and Laser droplet anemometry
3.	Crystallinity	Differential scanning calorimetry and X-ray diffraction

Characteristics

1. Drug Loading
2. Surface Modification
3. Tumor Targeting

Routes of administration

Intravenous administration
Subcutaneous or intramuscular injection
Ophthalmic application

References

Grottkau BE, Cai X, Wang J, Yang X, Lin Y. Polymeric nanoparticles for a drug delivery system. *Curr. Drug. Metab.* 2013 Oct;**14(8)**:840-846.

Nagavarma BVN, Yadav HKS, Ayaz A, Vasudha LS, Shivakumar HG. Different techniques for preparation of polymeric nanoparticles - A Review. *Asian. J. Pharmaceut. Clin. Res.* 2012 Jun;5(3):16-23.