Table 45.5 Examples of products developed using drug nanoparticles

Product	Drug	Attributes
Emend®	Aprepitant	An oral capsule form of the poorly soluble drug, Aprepitant, which is only absorbed in the upper gastrointestinal tract. Therefore the rapid dissolution offered by the nanocrystals, supports fast absorption and increased bioavailability.
Megace ES®	Megesterol acetate	The ES in the product title stands for Enhanced Stability. This product is a liquid dosage form and the nanosized version of the drug allows for the drug to be formulated in less volume. The reduced dose volume, improved dissolution times, and enhanced bioavailability are beneficial in drug compliance.
Rapamune®	Sirolimus	This is an oral tablet of the poorly soluble drug which is an immunosuppressant. The oral tablet offers higher bioavailability and can be more user friendly compared to a liquid product.
TriCor®	Fenofibrate	Generally, fenofibrate uptake is from the gut lumen region therefore bioavailability is influenced by the patient's fed/non-fed state. By formulating as nanocrystals, the lipophilic drug has improved solubility therefore uptake of the drug is not influenced by solubilization of the drug in food components.

Solid polymeric nanoparticles

In addition to their production by size reduction of drug particles, solid nanoparticles can be formed from polymers with the drug incorporated within the polymer matrix or associated onto the particle surface. As such, the delivery system can be loaded with a wide range of drugs (e.g. water-soluble and low-solubility drugs, small and large molecular weight drugs, small molecules and proteins) and can offer protection to the drug. Incorporation of the drug into solid polymeric nanoparticles also allows for modified drug biodistribution as the drug pharmacokinetic profile will be dictated by the properties of the nanoparticle attributes rather than those of the drug.

Polymeric nanoparticles are generally formulated from natural or synthetic polymers with the most commonly studied polymers being those which are biodegradable, such as poly(lactide-co-glycolide) (PLGA), polylactic acid (PLA), polycaprolactone (PCL) and polysaccharides (particularly chitosan). The advantage of these polymers is that they are well characterized and used in a range of clinical products, particularly PLGA. In terms of drug delivery, the main areas in which polymeric nanoparticles are being considered is for their ability to promote passive targeting of drugs to tumour sites via the EPR effect. Similar to the other nanotechnology systems discussed, the surface coating of PEG to these nanoparticles produces so called 'stealth' nanoparticles with the hydrated PEG surface coating prohibiting protein and antibody binding, thereby reducing recognition and clearance from the circulation. By increasing plasma circulation time of the polymeric nanoparticles, this supports their accumulation at sites of leaky vasculature including tumour sites. To formulate these 'stealth' systems, PEG-PLGA copolymers are often employed. Alternatively, active targeting of these systems can be achieved by the attachment of targeting groups to the nanoparticles.

Solid-lipid nanoparticles

These are nanoparticles made from solid (high melting point) lipids dispersed in an aqueous phase. Examples of lipids used include solid triglycerides, saturated phospholipids and fatty acids which are well tolerated by the body. Due to their composition, they are sometimes described as *solidified o/w emulsions* in which the oil globule is replaced by solidified lipid. Much like the solid polymeric nanoparticles, solid-lipid nanoparticles can be used as drug delivery systems with the drug being incorporated within the lipid matrix of the particle or by attaching the drug to the lipid nanoparticle surface. Lipid particles normally have a size greater than