# A New Leap in Drug delivery

August 30 2005

*by Dr. Bikram Lamba*

For most of the industry's existence, pharmaceuticals have primarily consisted of simple, fast-acting chemical compounds that are dispensed orally or as injectables. During the past three decades formulations that control the rate and period of drug delivery (i.e., time-release medications) and target specific areas of the body for treatment have become increasingly common and complex. Because of researchers' ever-evolving understanding of the human body and the explosion of new and potential treatments resulting from discoveries of bioactive molecules and gene therapies, pharmaceutical research hangs on the precipice of yet another great advancement.

However, this next leap poses questions and challenges to not only the development of new treatments but also the mechanisms with which to administer them. The current methods of drug delivery exhibit specific problems that scientists are attempting to address. Many drugs' potencies and therapeutic effects are limited or otherwise reduced because of the partial degradation that occurs before they reach a desired target in the body. Once ingested, time-release medications deliver treatment continuously, rather than providing relief of symptoms and protection from adverse events solely when necessary. Further, injectable medications could be made cheaper and administered more easily if they could simply be dosed orally. However, this improvement cannot happen until methods are developed to safely shepherd drugs through specific areas of the body, such as the stomach, where low pH can destroy a medication, or through an area where healthy bone and tissue might be adversely affected.

The goal of all sophisticated drug delivery systems, therefore, is to deploy medications intact to specifically targeted parts of the body through a medium that can control the therapy's administration by means of either a physiological or chemical trigger. To achieve this goal, researchers are turning to advances in the worlds of micro- and nanotechnology. During the past decade, polymeric microspheres, polymer micelles, and hydrogel-type materials have all been shown to be effective in enhancing drug targeting specificity, lowering systemic drug toxicity, improving treatment absorption rates, and providing protection for pharmaceuticals against biochemical degradation. In addition, several other experimental drug delivery systems show exciting signs of promise, including those composed of biodegradable polymers.

The researchers are investigating the properties of block copolymers (networks formed through the joint polymerization of two or more different monomers). These supramolecular networks, when composed of cross-linked combinations of hydrophilic and hydrophobic monomers, are called polymer micelles, and they self-arrange in shell-like structures with their hydrophilic and hydrophobic ligands aligned on opposing sides.

These micelles are only tens of nanometers in diameter and are thus ideally sized for enclosing individual drug molecules. Further, their hydrophilic outer shells help protect the cores and their contents from chemical attack by the aqueous medium in which they must travel. Finally, drug release is achieved via common polymer degradation mechanisms, with the specificity of the delivery (e.g., cell-specific drug targeting) controlled by the synthetic design.

Most micelle-based delivery systems are formed from a poly (ethylene oxide)-b-poly(propylene oxide)-b-poly(ethylene oxide) triblock network or a polypeptide and poly(ethylene oxide) combination. The results of these and other micellizations have proved quite promising. For

example, in one investigation, researchers at the University of Tokyo, led by Kazunori Kataoka, have investigated the use of micelles as a means of delivering doxorubicin (a hydrophobic anticancer agent). Preliminary results have shown that, when dosed intravenously, the system can withstand the body's normal blood circulation and effectively deliver the medication to a solid cancerous tumor. This is a watershed in the drug delivery system.

*Dr. Bikram Lamba, an international management consultant, is Chairman & Managing Director of Tormacon Limited- a multi-disciplinary consultancy organization. He can be contacted at 905 848 4205. email: torconsult@rogers.com,* www.torconsult.com