Bioplastics for use in medical industry

Sir,

Polyhydroxyalkanoates (PHAs) are the bio-based, biodegradable polymers with comparable properties to petroleum-based plastics in many applications.[1] PHA microstructures can be formed in bacterial hosts and findings suggest that PHAs are suitable to develop devices such as hernia repair devices, nerve repair devices, repair patches, cardiovascular patches, adhesion barriers, guided tissue repair and regeneration devices, nerve guides, orthopedic pins, tendon repair devices, bone-marrow scaffolds, tissue engineered cardiovascular devices, other implantable medical devices, such as sutures, meshes, cochlear implants, dental implants, and wound dressings.[2] These materials are biocompatible and can degrade after being implanted that suggest another application in drug release kinetics.

For use in medical applications, biodegradable polymers should not cause severe immune reactions when introduced to soft tissues or blood of a host organism. Even these materials should not provoke immune responses during degradation in the body. Importantly, PHA-degraded products are nontoxic in nature.[2] PHA matrices was tested for hemocompatibility by inspecting the response of mammalian blood when incubated with polymer films, whereas report suggested that poly-3-hydroxybutyrate (PHB) or P (HB-co-3-hydroxyvalerate), when in contact with blood, did not affect platelet responses, nor did the polymer activate the complement system.[2,3] Biodegradability without toxicity makes PHAs attractive as biomaterials for applications in both conventional medical devices and tissue engineering. The mechanical and biocompatibility of PHA can also be changed by inert blending, combining PHA with other polymers and inorganic materials or modifying the surface makes it possible for a wider range of applications.[2] Polymer matrix characteristics such as rate of controlled release, degradation, swelling and strength can be precisely controlled by the appropriate combination of suitable material. These modifications also allow development of products into various shapes and configurations, thereby allowing them to be used in a wide range of applications.[4] Over the past years, PHA particularly PHB and other copolymers were reported to develop medical and surgical devices.

Permanent implants cause various problems, such as, chronic inflammatory local reactions, physical irritations, repeat surgery, inability to adapt to growth, stress shielding, corrosion, accumulation of metal in tissues, thrombogenicity and long-term endothelial dysfunction etc., whereas biodegradable medical implants possess many advantages such as good biocompatibility, more physiological repair, possibility of tissue growth, temporary support during tissue recovery, gradual dissolution or absorption by the body afterwards, less invasive repair, ability to immobilize cells or biomolecules within them or on the surface (drug eluting stent). These properties make biodegradable medical implants one of the fastest growing areas in the global biomedical market. Orthopedics is one of most versatile segment where biomaterials are used in a range of surgical applications, including joint replacements, fracture fixation plates, bone defect fillers, artificial tendons and ligaments and bone cements.[5]

Another growing interest is the use of biodegradable polymers for site specific drug delivery; these polymers containing an entrapped drug can be placed in the body, and they are used for localized drug delivery accompanied with the controlled release of a drug over a period of time. Degradation of PHA polymers in the tissues of the host organism either as coatings on medical devices or as devices offers the possibility to link this phenomenon with the release of bioactive compounds, such as antibiotic or anticancer drug.[6] These biocompatible and hydrophobic polymers can also be introduces as films, porous matrices, microcapsules, microspheres, and nanoparticles where drugs can be entrapped or microencapsulated in a PHA homopolymer or copolymer. In the past few years, microsphere or microcapsule-based delivery systems have been reported for the delivery of a number of drugs such as antitumor agents, anti-inflammatory agents, anesthetics, antibiotics, hormones, steroids, and vaccine.[3]

As the benefits of biodegradable medical implants become more widely known and acceptable, there is much excitement around to explore potential capabilities of biodegradable polymers and the effect they will have on the design and function of implants. Biodegradable devices are now considered as a foundation for new drug delivery technology, as its biodegradability and linear release properties make it an excellent technology for the controlled release of the active ingredient or agent to further assist the healing process.[2] Release profile of a drug can be completely controlled and degradation rate allows both local and systemic administration of drug.[2,4] The current trend suggests that, in the next few years, new development in the technology will give way to full biomedical exploration of degradable devices.

Though, the slow evolution of degradable polymers has so far put the brakes on this transition, but the best will come out soon.

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