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Biomedical Applications of Polyhydroxyalkanoates

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Polyhydroxyalkanoates (PHA) is a group of polymers synthesized by wide range of (more than 300 species) of microorganisms as an intracellular carbon and energy storage compounds [1]. The trend in polymer science over the last century has been towards the development & commercialization of biopolymers in replacing existing synthetic plastics, because the synthetic plastics declined to meet their environmental value needs. The well-known member of Polyhydroxyalkonate (PHA) is Polyhydroxybutyrate (PHB) contains repeating units of (R)-3HB. Polymerization of these polymers yield a high molecular weight polymer at a range of 200,000 to 3,000,000 Da, it depends on microorganisms and their growth conditions. The flexibility of PHAs has made them excellent candidates for the potential areas from household, textile, packaging, food and biomedical fields. Earlier applications of PHA mainly applied in the areas of preparing bags, paper coatings, containers and other packaging materials. In recent years Biodegradable polymers are finding significant applications in the medical field. P (4HB), P (3HB-3HHx), P (3HB), P (3HO) and P (3HB-3HV) are frequently used in tissue engineering. A member of PHA family, medium chain length PHAs (PHB) has interesting potential applications in coatings and in medical temporary implants such as scaffolding for the regeneration of arteries and nerve axons [2]. The combination of polymer science with pharmaceutical sciences has led to a quantum jump in terms of 'novelty' in design and development of novel drug delivery systems (DDSs). Polymers play an important role in control of drug release and fabrication of drug delivery devices.

In recent days, many types of different polyesters are used as substitutes for scaffold materials, vascular system, and arterial tissues in combination with ceramic materials; wound management (sutures, dusting powders and dressing); maxillofacial treatment (guiding tissue and bone regeneration) [3]. Dental, urology material for cardiac tissue engineering, orthopedy, and computer supported tomography, ultrasound imaging and drug delivery (tablets, implants and micro-carriers). Besides, PHAs has critical role as structural component of extra cellular matrix with pivotal functions in the tissue metabolism. The expanding utility of HA-based materials in translational applications is particularly due to the processing capabilities, biocompatibility and efficacy of these materials. PHAs has been very well examined against various cell lines with a target for use as biomaterials [4]. Thus, the biodegradable nature of PHAs ensures that their use as biomaterials would not be questioned given their apparent persistence after implantation, allowing them to achieve the target objective. It is most likely that the coming years will witness an expansion in this area of research through newer material development with unique and interesting properties.

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