Jaisankar, P. Synthesis and antibacterial evaluation of 3,3′-diindolylmethane derivatives. *Med. Chem. Res.* **2014**, *23*, 1371–1377. (b) Sung, W. S.; Lee, D. G. *In vitro* antimicrobial activity and the mode of action of indole-3-carbinol against human pathogenic microorganisms. *Biol. Pharm. Bull.* **2007**, *30*, 1865–1869. (c) Ko, M.-O.; Kim, M.-B.; Lim, S.-B. Relationship between chemical structure and antimicrobial activities of isothiocyanates from cruciferous vegetables against oral pathogens. *J. Microbiol. Biotechnol.* **2016**, *26*, 2036–2042. (d) Kumar, G. S. S.; Kumaresan, S.; Prabhu, A. A. M.; Bhuvanesh, N.; Seethalakshmi, P. G. An efficient one pot syntheses of aryl-3,3′-bis(indolyl)methanes and studies on their spectral characteristics, DPPH radical scavenging-, antimicrobial-, cytotoxicity-, and antituberculosis activity. *Spectrochim. Acta - Part A Mol. Biomol. Spectrosc.* **2013**, *101*, 254–263.

(10) (a) Bhowmik, A.; Das, N.; Pal, U.; Mandal, M.; Bhattacharya, S.; Sarkar, M.; Jaisankar, P.; Maiti, N. C.; Ghosh, M. K. 2,2′-Diphenyl-3,3′-diindolylmethane: A potent compound induces apoptosis in breast cancer cells by inhibiting EGFR pathway. *PLoS One* **2013**, *8*, e59798. (b) Andey, T.; Patel, A.; Jackson, T.; Safe, S.; Singh, M. 1,1-Bis (3′-indolyl)-1-(*p*-substitutedphenyl)methane compounds inhibit lung cancer cell and tumor growth in a metastasis model. *Eur. J. Pharm. Sci.* **2013**, *50*, 227–241. (c) Ichite, N.; Chougule, M.; Patel, A. R.; Jackson, T.; Safe, S.; Singh, M. Inhalation delivery of a novel diindolylmethane derivative for the treatment of lung cancer. *Mol. Cancer Ther.* **2010**, *9*, 3003–3015.

Chapter 9

BIOMEDICAL APPLICATIONS OF POLYMERS

Dr. Jasna V.C

Assistant professor, PG Department of Chemistry,

KAHM Unity Women's College, Manjeri, Kerala, India, 676122

E-mail: jasnavc@gmail.com

ISBN 978-93-5457-774-1

INTRODUCTION

Polymers are versatile materials that are widely used in biomedical applications due to their unique properties such as biocompatibility, biodegradability, and ease of processing. In this chapter, we will discuss some of the major biomedical applications of polymers, including implantation, drug delivery, medical devices, and tissue engineering.

POLYMERS IN IMPLANTATION

Implantation is a common medical practice that involves inserting a foreign material into the body for therapeutic or diagnostic purposes. Polymers are commonly used in implantation due to their biocompatibility, mechanical strength, and ability to be modified for specific applications. Examples of polymer-based implants include: Cardiovascular stents: Stents are used to prop open narrowed or blocked blood vessels in the heart. Polymers such as polyethylene terephthalate (PET) and polytetrafluoroethylene (PTFE) are commonly used in cardiovascular stents due to their high strength, biocompatibility, and ability to prevent restenosis (1).

Orthopedic implants: Orthopedic implants such as hip and knee replacements are commonly made from polymers such as ultra-high molecular weight polyethylene (UHMWPE) and polyetheretherketone (PEEK). These polymers are chosen for their high strength, wear resistance, and biocompatibility (2). Neural implants: Neural implants are used to treat a variety of neurological disorders such as Parkinson's disease and epilepsy. Polymers such as polyimide and silicone are commonly used in neural implants due to their biocompatibility and flexibility (3).

POLYMERS IN DRUG DELIVERY

Drug delivery is the process of administering drugs to the body in a controlled manner to achieve a desired therapeutic effect. Polymers are commonly used in drug delivery due to their ability to control drug release and protect drugs from degradation. Examples of polymer-based drug delivery systems include:

ISBN 978-93-5457-774-1

Polymeric nanoparticles: Polymeric nanoparticles are used to deliver drugs to specific sites in the body such as tumors. Polymers such as poly(lactic-co-glycolic acid) (PLGA) and polyethylene glycol (PEG) are commonly used in polymeric nanoparticles due to their biocompatibility and ability to control drug release (4). Hydrogels: Hydrogels are three-dimensional networks of polymers that can absorb and retain large amounts of water. Hydrogels are used in drug delivery to control drug release and protect drugs from degradation. Polymers such as polyvinyl alcohol (PVA) and polyethylene glycol diacrylate (PEGDA) are commonly used in hydrogels due to their biocompatibility and ability to mimic the natural extracellular matrix (5). Mucoadhesive polymers: Mucoadhesive polymers are used to improve the bioavailability of drugs by prolonging their residence time at the site of administration. Polymers such as chitosan and alginate are commonly used in mucoadhesive drug delivery systems due to their biocompatibility and ability to adhere to mucosal surfaces (6).

POLYMERS IN MEDICAL DEVICES

Polymers are widely used in medical devices due to their unique properties and versatility. Here are some examples of how polymers are utilized in medical devices: Intraocular lenses (IOLs): IOLs are used to replace the natural lens of the eye in cataract surgery. Polymers such as silicone, acrylic, and hydrophilic materials are commonly used in IOLs due to their biocompatibility, optical clarity, and ease of processing (7). Dental implants: Polymers are used in dental implants to improve their mechanical and biological properties. Polyetheretherketone (PEEK) is commonly used in dental implants due to its high strength, biocompatibility, and ability to integrate with surrounding tissues (8) Catheters: Catheters are used to deliver fluids or medications to different parts of the body. Polymers such as silicone and polyurethane are commonly used in catheters due to their biocompatibility, flexibility, and ability to resist kinking and deformation (9).

POLYMERS IN TISSUE ENGINEERING

Tissue engineering is a rapidly growing field that involves creating functional tissues and organs in the laboratory for transplantation. Polymers are widely used in tissue engineering due to their ability to mimic the extracellular matrix, support cell growth and

ISBN 978-93-5457-774-1

differentiation, and promote tissue regeneration. Here are some examples of polymer-based tissue engineering:

Scaffolds: Scaffolds are three-dimensional structures that provide a framework for cells to grow and differentiate. Polymers such as poly(lactic acid) (PLA), poly(glycolic acid) (PGA), and their copolymers (PLGA) are commonly used as scaffolds in tissue engineering due to their biocompatibility, biodegradability, and ability to control cell behavior (10).

Hydrogels: Hydrogels are also used as scaffolds in tissue engineering due to their ability to mimic the extracellular matrix and promote cell adhesion and proliferation. Polymers such as PEG and gelatin are commonly used in hydrogels due to their biocompatibility, tunable mechanical properties, and ability to control cell behavior (11).

Tissue adhesives: Tissue adhesives are used to seal wounds and promote tissue regeneration. Polymers such as fibrin and chitosan are commonly used in tissue adhesives due to their biocompatibility, biodegradability, and ability to promote cell adhesion and proliferation (12).

CONCLUSION

Polymers are versatile materials that are widely used in biomedical applications such as implantation, drug delivery, medical devices, and tissue engineering. The selection of a specific polymer and its modification depends on the specific application and desired properties. With the continuous development of new polymers and modification techniques, the future of biomedical applications of polymers is promising.

REFERENCES

1. Rani V, Deepak D. Recent developments in biodegradable polymers and their composites in cardiovascular stent application: a review. Polym Plast Technol Eng. 2019;58(6):576-595.
2. Bajpai SK, Chand N. Polymeric biomaterials for orthopaedic implants. Curr Sci. 2007;93(9):1233-1243.
3. Anderson JM, Shive MS. Biodegradation and biocompatibility of PLA and PLGA microspheres. Adv Drug Deliv Rev. 1997;28(1):5-24.

ISBN 978-93-5457-774-1

4. Torchilin VP. Multifunctional nanocarriers. Adv Drug Deliv Rev. 2012;64(Suppl):S153-S162.
5. Hennink WE, van Nostrum CF. Novel crosslinking methods to design hydrogels. Adv Drug Deliv Rev. 2012;64(Suppl):S223-S236.
6. Smart JD. The basics and underlying mechanisms of mucoadhesion. Adv Drug Deliv Rev. 2005;57(11):1556-1568.
7. Nishi Y, Hara T, Hara T. Biocompatibility of intraocular lenses. J Artif Organs. 2008;11(1):7-14.
8. Park JH, Ye Q, Tassa C, et al. Bioinspired polymer vesicles and membranes for biological and medical applications. Chem Soc Rev. 2013;42(21):8803-8821.
9. Al-Mahrouqi HH, Bowmaker GA, Fitzgerald M, Grover LM. Medical device coatings for the prevention of infection. Prog Biomater. 2014;3:15.
10. O'Brien FJ. Biomaterials & scaffolds for tissue engineering. Mater Today. 2011;14(3):88-95.
11. Hoffman AS. Hydrogels for biomedical applications. Adv Drug Deliv Rev. 2012;64(Suppl):S18-S23.
12. Tan H, Marra KG. Injectable, biodegradable hydrogels for tissue engineering applications. Materials. 2010;3(3):1746-1767.

Chapter 10

CARBOHYDRATES AS CORROSION INHIBITORS

Dr. Shamsheera K O

Assistant Professor, Department of Chemistry, KAHM Unity Women's College, Manjeri.

E-mail: shamsimanu@gmail.com

All-natural processes tend towards the lowest possible energy state by a spontaneous reaction. Corrosion is a perpetual deterioration of metal or material owing to its reaction with different aggressive environments causing massive economic loss, primarily in the petroleum industries, and in aerospace. Metals can be protected against corrosion by introducing an inhibitor in an aggressive aqueous environment at a small concentration. Traditional

ISBN 978-93-5457-774-1