ligands, and soluble factors which may be needed to promote layered growth of cells in replacement tissues and organs. Expanding our present understanding of the core properties of alginate, and developing innovative types of cell and tissue-interactive alginate gels, would cultivate future growth in biomedical science and engineering.

2.6 Conclusions

Recent developments in the control of alginate biosynthesis in microbes, and the comparative simplicity of bacteria modification, may allow production of alginate with tailor-made characteristics, suitable to specific application in biomedical procedures and products. X-ray diffraction and infrared spectroscopy have been used to delineate the structure of alginates, and more advanced analytical methods are being standardized. Characterization of properties such as cross-linked nature, which affect solubility at different pH, and storage stability of dried powder forms has become essential to achieve pharmaceutical, biomedical, and food processing applications, with the present commercial availability of widely varying grades of alginic acid and sodium, calcium salts of alginic acid from different sources and extraction procedures. A significant portion of research has targeted the chemical modification of alginate, at the free hydroxyl and carboxyl groups occurring along the backbone, to favorably change the viscosity, gelling, water absorption, and mechanical strength relative to the native alginates. However, only a few chemically modified derivatives of alginate such as modified esters, amides, and specifically propylene glycol alginate have come into industrial use, and many more are expected to mainstream into commercial use in the near future in biomedical, health, and cosmetic products.

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