

Biopolymers: Structure, properties, extraction methods and applications

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Abstract

Polymers are natural or synthetic macromolecules with repeating units. Biopolymers are polymeric materials derived from living organisms. The use of these biopolymers has grown significantly in recent years due to their renewability, abundance, biodegradability, low immunogenicity and other unique properties. This review article is focused on several types of biopolymers such as polysaccharides; cellulose, starch, proteins; collagen, silk, and agar. It will discuss the importance of these polymers, their physical and chemical properties, extraction methods and finally applications of those polymers.

Keywords: Biopolymers, Cellulose, Chitin, Agar, Starch, Collagen, Silk.

1. Introduction

The term polymer is derived from the ancient Greek word "Polus" which means many and "meros" which means parts. Polymers are macromolecules composed of repeating units. Monomers have the ability to react with another molecule of the same type or different type at suitable conditions to form a polymer chain [1]. Their large molecular weights lead to unique physical and mechanical properties including rigidity, viscosity, and the tendency to form glass and semi crystalline structures rather than crystals. Polymers can be considered as important components of highly functional materials in the fields of chemical, electronic, optical, pharmaceutical and medical industries.

Bio polymers is a sub category of polymers which are defined as polymers derived from biological origin. Most of the biopolymers are bio-degradable with the action of micro-organisms, heat or moisture. Therefore, industries tend to move towards biopolymers to avoid the environmental issues comes from conventional synthetic non-degradable polymers.

The main objective of this review is to discuss about structure, properties, extraction methods and applications of biopolymers.

2. Discussion

2.1 Biopolymers

According to the definitions biopolymers are derived from biological origin. Biopolymers can be simply extracted as natural polymers produced in biological systems or chemically synthesised from biological raw materials. Natural polymers are produced by living

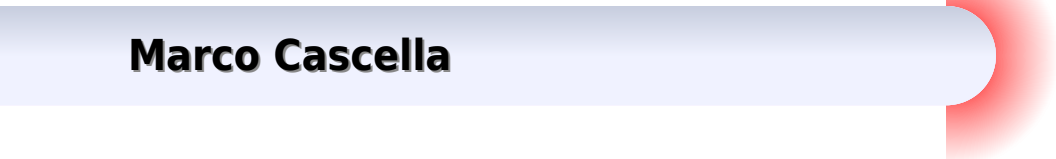
organisms in nature such as trees, plants, animals, and microorganisms etc. [2]. They are produced within the natural cells by complex metabolic processes [3]. The monomeric units of natural biopolymers are covalently bonded to form the corresponding polymer. Those materials can be degraded by the action of microbial enzymes. [3]. Biopolymers are considered as the most promising materials due to their competitive mechanical properties and biodegradability [4].

There are some major reasons which encourage the use of biopolymers. Industries focusing on biopolymers due to some drawbacks of synthetic polymers including use of non-renewable fossil resources and greenhouse gas emissions during the synthesis, environmental pollution due to non-degradability, and human health impacts [5]. Biopolymers are sustainable since they are composed from living materials [6]. They are carbon neutral and their sources are renewable. Biopolymers can decrease the carbon dioxide levels and carbon emission in the atmosphere. Even though bio-degradation of biopolymers can release carbon dioxide, it will be reabsorbed by the crops grown to use as the source of biopolymer [7]. After the use of particular application, they can be discarded to the environment because they are compostable. Therefore, chances of polluting environment from these compounds are less. These biopolymers reduce the dependency on non-renewable fossil fuels and it will limit the use of fossil fuels [6].

Biopolymers can be used vastly for tissue engineering, medical devices and the pharmaceutical industry, drug delivery, and overall medical applications due to their physio-mechanical properties. Further, they have specific characteristics like wound healing, catalysis of bio-activity, and non-toxicity. Compared to synthetic polymers, many biopolymers are normally better with bodily integration as they also possess more complex structures.

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