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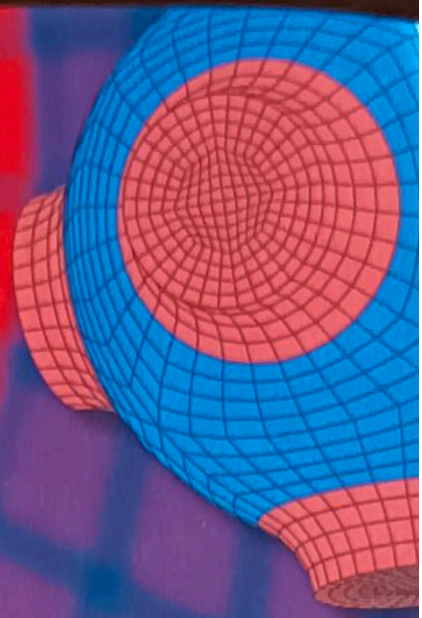

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Bioactive Natural Products for Pharmaceutical Applications

Springer

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Chapter 3
Plant Polysaccharides in Pharmaceutical Applications

Amit Kumar Nayak, Md Saquib Hasnain, Amal Kumar Dhara, and Dilipkumar Pal

Abstract Plant polysaccharides are the by-products of photosynthesis within the plants and are being extracted from different parts of the plants, such as leaves, pods, fruits, seeds, cereals, stems, roots, rhizomes, corms, exudates, etc. The important advantages for the uses of plant polysaccharides include easy availability from the nature as plant resources are abundant, sustainable and low cost production, biodegradability, biocompatibility, water solubility, swelling ability, etc. Since long, numerous plant polysaccharides have already been explored and exploited as excipients in a variety of common pharmaceutical dosage forms, such as suspensions, emulsions, gels, tablets, capsules, beads, microparticles, nanoparticles, liposomes, transdermal formulations, buccal formulations, nasal formulations, ophthalmic formulations, etc. The current chapter presents a brief review on the pharmaceutical applications of various plant polysaccharides.

Keywords Plant polysaccharides · Biopolymers · Excipient · Pharmaceutical applications · Drug delivery

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3.1 Introduction

An inspiring array of plant-derived materials and products have already been revealed for the uses in many applications including pharmaceuticals, cosmeceuticals, biomedical, foods, textiles, paints, paper-making, etc. (Ali et al. 2019; George and Suchithra 2019; Hasnain et al. 2019a; Nayak et al. 2020; Pal et al. 2019a; Sinha Mahapatra et al. 2011; Xie et al. 2016). Amongst the different plant-derived materials, plant polysaccharides have already been demonstrated as a useful group of polymeric biomacromolecules possessing some outstanding merits over the synthetic polymers and these merits include easy availability from the nature as plant resources are abundant, sustainable and low cost production, biodegradability, biocompatibility, water solubility, swelling ability, etc. (Nayak and Hasnain 2019a; Nayak et al. 2018a). The most important reason for the rising interest for the uses of various plant polysaccharides is the advantages of easy cultivation and harvesting to offer a constant supply of raw plant materials for the polysaccharide extractions. Plant polysaccharides are the by-products of photosynthesis within the plants and are being extracted from different parts of the plants, such as leaves, pods, fruits, seeds, cereals, stems, roots, rhizomes, corms, exudates, etc. (Prajapati et al. 2013). These are high molecular weight biopolymers possessing many monosaccharidic units as building blocks, which are linked each other by O-glycosidic linkages in different patterns (Nayak and Pal 2016). Similar or different monosaccharidic units are arranged as extremely complex molecular structures with the variations in sequences, linkages, branching patterns and distributions of side chains. In addition, the molecular structural features of plant polysaccharides possess the presence of many functional groups, which can be modified or tailored to produce polysaccharides of desirable quality (Nayak and Pal 2018; Nayak et al. 2018b). During past few decades, an extensive volume of research efforts have been directed to use various plant polysaccharides in many biomedical and medical applications including their pharmaceutical uses as the dosage formulation excipients and dosage performance enhancers in terms of desired pattern of drug releasing, improved drug stability, enhanced bioavailability, desired target specificity, etc. (Nayak and Hasnain 2019a; b; Pal and Nayak 2017).

Various useful plant polysaccharides have already been explored and exploited as biopolymeric agents in many healthcare area including pharmaceutical industry and researches. Some of the widely used plant polysaccharides as efficient excipients in various kinds of pharmaceutical dosage forms are gum Arabic (Nayak and Hasnain 2019c), gum tragacanth (Dhupal et al. 2019), pectin (Nayak and Pal 2016), guar gum (Jana et al. 2019), locust bean gum (Hasnain et al. 2019b; Nayak and Hasnain 2019d), sterculia gum (Bera et al. 2019; Nayak and Hasnain 2019e), tamarind gum (Dey et al. 2019; Nayak, 2016; Nayak and Hasnain 2019f), cashew gum (Nayak et al. 2019), okra gum (Nayak and Hasnain 2019g; Nayak et al. 2018b), gum odina (Samanta et al. 2019), fenugreek seed mucilage (Nayak and Hasnain 2019h; Pal et al. 2019b), linseed polysaccharides (Nayak and Hasnain 2019i), ispaghula mucilages (Guru et al. 2018), plant starches (Nayak and Pal