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Review

Pectins functionalized biomaterials; a new viable approach for biomedical applications: A review

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ABSTRACT

Pectins are natural complex heteropolysaccharides, composed of (1, 4)-linked α-D-galacturonic acid residues and variety of neutral sugars such as rhamnose, galactose and arabinose. It is second most abundant component of the cell wall of all land plants. It has wide applications in various fields due to its use as gelling, emulsifying or stabilizing agent and as well as its non-toxic, biocompatible and biodegradable nature. Considering these versatile properties this review sheds a light on the synthesis, modification, characterization and applications of pectin based polymers. Most of them are used in industries, pharmaceutics, nutraceutics, drug delivery, tissue engineering, food packaging and cosmetics. Properties of pectin can be improved and modified by forming derivatives, blends and composites.

Contents

Abbreviations: 5ASA, 5-aminosalicylic acid; 5-FU, 5-fluorouracil; β-LG, β-lactoglobulin; AA, ascorbic acid; GalA, galacturonic acid; AG, arabinogalactan; AGP, arabinogalactan-protein complex; BC, bacterial cellulose; BNC, bionanocomposite; CdS, cadmium Sulfide; CMC, carboxymethyl cellulose; CP/MAS, cross polarization/magic angle spinning; CS, chondroitin sulfate; CSNC, chitosan nanocomposite; CSNP, chitosan nano particles; DDS, drug delivery systems; DE, degree of esterification; DLS, dynamic light scattering; DS, degree of substitution; DSC, differential scanning calorimetry; DTA, differential thermal analysis; ECM, extra cellular matrix; EDS, energy-dispersive X-ray spectroscopy; FESEM, field emission scanning electron microscope; FT-IR, Fourier transform infrared; GA, gum arabic; GC–MS, gas chromatography–mass spectrometry; GIT, gastrointestinal tract; GP, glycoprotein; GPC-MALLS, gel permeation chromatography-multi angle light scattering; HG, homogalacturonan; HMP, high methoxyl pectin; HNT, halloysite nanotubes; HPMC, hydroxyl propyl methyl cellulose; HPSEC, high pressure size exclusion chromatography; HS-SPME, headspace-solid phase microextraction; ITC, isothermal titration calorimetry; ITZ, itraconazole; LbL, layer-by-layer; LMP, low methoxyl pectins; LDH, layered double hydroxide; MB, methylene blue; MFC, microfibrillated cellulose; NMR, nuclear magnetic resonance; OSA, octenyl succinic anhydride; PPI, Pea protein isolate; PEC, polyelectrolyte complex; PEG, polyethylene glycol; PEO, polyethylene oxide; PGPR, polyglycerol polyricinoleate; PIA, poly(itaconic acid); PL, polylysin; PVA, poly(vinyl alcohol); RG, rhamnogalacturonan; SBP, sugar beet pectin; SEM, scanning electron microscopy; TEM, transmission electron microscopy; TGA, thermogravimetric analysis; TWM, thorium (IV) tungstomolybdate; XRD, X-ray diffraction; XPS, X-ray photoelectron spectroscopy; WAXD, wide-angle X-ray diffraction; GIT, gastrointestinal tract; WPI, whey protein isolate; WVP, water vapour permeability.

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1. Introduction

Polysaccharides (also known as polyholosides or polyosides or glycanes) are high molecular weight carbohydrates which on hydrolysis form various monosaccharides. These are naturally occurring polymers found in animals, plants and microbial worlds, where they act as a source of biological activities, as structural materials and as energy storage component. They are also considered as the polymeric anhydrides of simple sugars [1]. In polysaccharides, monosaccharides are linked through glycosidic linkage by condensation reaction [2–8]. D-Glucose is the most common monosaccharide present in polysaccharides. However, D-and L-galactose, D-xylose, L-arabinose, D-mannose, D-glucuronic, D-mannuronic acids, D-glucosamine, D-galactosamine, D-galacturonic, and amino uronic acids are also present in polysaccharides [1]. Polysaccharides differ from each other not only in the composition of the monosaccharide but also in nature of chain whether linear or branched, in molecular weight, in the type of glycosidic bond whether α or β and the linkage type (1→2, 1→3, 1→4, or 10→6) in alternate monosaccharide units. In nature, majority of carbohydrates are found as polysaccharides [1,2,9,10].

1.1. Types of polysaccharides

Chemically, polysaccharides are classified into: