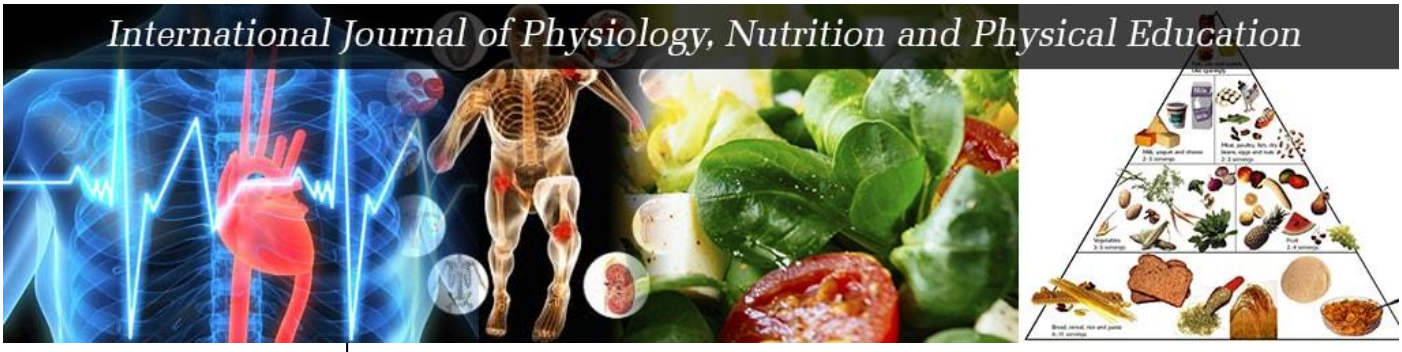


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# Pectin: Structure and biological activity

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**Abstract**
Structurally different pectin polysaccharides are composed of different monosaccharide units in different molar ratio. The structures of the pectin polysaccharide isolated from different plants are investigated using different experiments (acid hydrolysis, methylation analysis, periodate oxidation studies) and NMR spectroscopy techniques (1D & 2D-NMR). Different pectic polysaccharides isolated from different plant showed various biological activities. Reviews the structural and biological properties of pectin from different plants.

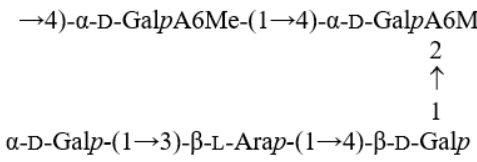
**Keywords:** Pectin, structure, biological activity

## Introduction
Pectins are a complex set of heterogeneous polysaccharides containing galacturonic acid or its ester in the backbone present in most primary cell walls of terrestrial plants were first isolated by Henri Braconnot [1] in 1825. Pectins are consisting of HG (homogalacturonan), RG-I (rhamnogalacturonan I) and RG-II (rhamnogalacturonan II) types [2]. HG composed of linear chains of poly-α-(1→4)-D-galacturonic acid. Rhamnogalacturonan I pectins (RG-I) consists of alternating sequences of Rha and GalA, with side chains at Rha moieties. Rhamnogalacturonan II pectins (RG-II) are highly branched polysaccharide, consists of alternating sequences of Rha and Gal A, with side chains at both the Rha and GalA moieties. The average molecular weight of pectins is in the order of $10^4$-$10^5$ Daltons depending on fruit source [3]. Pectins are an important part of human diet but do not play a significant role to nutrition. Pectins are available in apples, guavas, quince, plums, gooseberries, oranges and other citrus fruits, soft fruits like cherries, grapes and strawberries.
Pectins are used as gelling agent or thickening agent [4] for the production of jams and jellies. The acetyl groups and side chains on pectic polysaccharide are important for biological activities. The gelation process and the solubility depend on the degree of esterification [5]. Pectin plays an important role in improving gastrointestinal functions and also regulates some physiological processes. It showed anti-inflammatory activity by oral administration [6, 7, 8] and has different pharmaceutical activities [9, 10, 11]. Pectin can inhibit growth of tumor and metastasis [12, 13, 14] and also reduce blood glucose levels in normal and hyperglycaemic mice [15, 16]. Pectin protects gastric lesions [17], and also animals from the lethal effects of ionising radiation [18, 19]. In this review article the structure and biological activity of different pectins isolated from capsicum an, green bean, immature onion stick, Dendrobium nobile, roots of Angelica sinensis (Oliv.) Diels and *Panax ginseng* C. A. Meyer (Ginseng) are reported.

## Structure and biological activity
A pectic polysaccharide, capsicum an isolated from fresh sweet peppers (*capsicum annum*) [20] using a saline solution containing hydrochloric acid (pH 1.5) and pepsin at 37 $^0$C for 4 h. It was found to consist of D-galacturonic acid, rhamnose, arabinose and galactose residues and possess a backbone of 1, 4-alpha-D-galacturonan with partially substituted by methyl and O-acetyl ester groups. It is reported this pectin was found to decrease TNF-α release after 24 h of oral administration to mice at doses of 40–100 mg/kg and to increase production of interleukin-10 (IL-10) in lipopolysaccharide (LPS)-stimulated whole blood. TNF-α release by leukocytes was an important role in the inflammatory process. Capsicum an was found to improve the survival of mice that were subjected to a lethal dose of LPS.

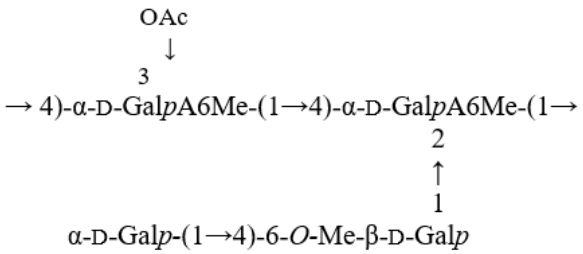
The present study demonstrates that the pectin capsicuman CA, which possesses anti-inflammatory

A water-soluble pectic polysaccharide (PS-I) [21] isolated from the hot water extract of the pods of green bean (*Phaseolus vulgaris* L.) by successive purification through dialysis, centrifugation and Sepharose-6B gel filtration was found to consist of methyl ester of D-galacturonic acid, D-galactose, and L-arabinose in a molar ratio of nearly 2:2:1 and contained [ → 4)-α-D-Gal*p*A6Me-(1→ 4)-α-D-Gal*p*A6Me-(1→ ] as a back bone in which branching occurred at C-2 position of one methyl galacturonate moiety by α-D-Gal*p*-(1→3)-β-L-Ara*p*-(1→ 4)-β-D-Gal*p*-(1→). The probable structure of repeating unit of PS-I is reported as:




It is reported that PS-I showed splenocyte and thymocyte proliferaton in mouse cell culture medium by the MTT [3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide] method. Splenocytes are the cells present in the spleen that include T cells, B cells, dendritic cells, etc. that stimulate the immune response in living organisms whereas thymocytes are hematopoietic cells present in thymus and the primary function of which is the generation of T cells. Splenocyte and thymocyte proliferations are the measurement of Immuno activation. So it acts as an efficient immunostimulator. The antioxidant activity of the pectic polysaccharide was studied by the scavenging activity against DPPH radical and the scavenging activity was less than that of ascorbic acid but it is appreciable and effective as an antioxidant material.

Another pectic polysaccharide (PS-II) [22] isolated from immature onion stick (*Allium cepa*) was found to consist of D-galactose, 6-*O*-Me-D-galactose, 3-*O*-acetyl-D-methyl galacturonate and D-methyl galacturonate in a molar ratio of nearly 1:1:1:1 and contained [→4)-α-D-Gal*p*A6Me-(1→4)-α-D-Gal*p*A6Me-(1→] as a backbone in which one methyl galacturonate was substituted at *O*-3 position by an acetyl group and the neighboring methyl galacturonate being substituted at *O*-2 with a side chain, α-D-Gal*p*-(1→ 4)-6-*O*-Me-β-D-Gal*p*-(1→). The structure of repeating unit of pectic polysaccharide is reported as:




This pectic polysaccharide enhanced macrophage activation by production of NO *in vitro* and acts as an efficient immunostimulating agent.

A pectic polysaccharide DNP-W5 (PS-III) isolated from Dendrobium nobile [23] was found to consist of mannose, glucose, galactose, xylose, rhamnose and galacturonic acid in molar ratios of 3.1:8.1:8.2:0.6:4.2:3.9. About 21% of the galacturonic acid existed as methyl ester and O-acetyl groups were approximately 6.9%. It is commonly used as a Yin tonic for reinforcing body fluid and nourishing blood. The structure of DNP-W5 was investigated using acid hydrolysis, methylation analysis, and NMR studies. The results of the above experiments indicated that the DNP-W5 possessed a backbone of a disaccharide of [→4)-α-Gal*p* A-(1→2)-α-Rha*p*-(1→] with branches at *O*-4 of the Rha*p* and *O*-3 of the Gal *p*A. The side chains consisted of galactosyl, mannosyl, glucosyl, and xylosyl residues. *In vitro*, DNP-W5 showed immunoenhancing activities on T- and B-lymphocytes and its branches and acetyl groups are very important for the expression of the immunological activity.

Another pectic polysaccharide (ASP3) [24] isolated from roots of Angelica sinensis (Oliv.) Diels contained galacturonic acid, rhamnose, galactose and arabinose. ASP3 composed of linear homogalacturonan fragments as ‘‘smooth regions” and rhamnogalacturonan fragments as ‘‘hairy regions” in the backbone with repeating unit of [→4)-α-D-Gal*p*A-(1→2)-α-L-Rha*p*A-(1→]. In the linear region some residues of galacturonic acid were methoxylated and contained O-acetyl groups on C-2 and/or C-3.

Ginseng pectin [25] isolated from medicinal plant, *Panax ginseng* CA. Meyer (Ginseng) was found to consist of rhamnogalacturonan I (RG-I) and rhamnogalacturonan II (RG-II) domains. Monoclonal antibody detection, enzyme hydrolysis, together with methylation and mass spectrum analysis indicated that ginseng RG-I showed disaccharide repeating backbone unit as →4)-α-GalpA-(1→2)-α-Rhap-(1→with side chains arabinan, galactan and type II arabinogalactan (AG-II). Ginseng RG-II contained 9 galacturonic acid units as backbone with two side chain consist of octasaccharide with 0 ~ 1 methyl ether group and another non-asaccharide with 0 ~ 1 acetyl group. These results showed valuable information for structure-activity relationship of ginseng pectin. Ginseng pectins (GPs) impair cell migration through decreasing cell adhesion and cell spreading [26]. They have anti-fatigue activity via reducing glucose and glutathione peroxidase and increase creatine phosphokinase, lactic dehydrogenase and malondialdehyde levels [27]. Ginseng pectins inhibit human colon cancer HT-29 cell proliferation accompanied by the activation of caspase-3; and induce cell cycle arrest in the G2/M phase [28].

**References**

1. Braconnot H, Keppler F. Nature 1825;439:187-190.
2. Albersheim P, Darvill AG, O’Neill MA, Schols HA, Voragen AGJ. In Visser J, Voragen AGJ. (Eds.) Progress in biotechnology, Pectins and pectinases, Amsterdam: Elsevier 1996;14:47-55.
3. Corredig M, Kerr W, Wicker L. Food Hyrdocolloids 2000;14:41-47.
4. Voragen AGJ, Pilnik W, Thibault JF, Axelos MAV, Renard CMGC. Pectins. In A. M. Stephen (Ed.), Food polysaccharides and their applications 1995, 287-339. Marcel Dekker: New York.
5. Murano E. J Appl. Ichthyol 1998;14:245-249.
6. Ovodova RG, Golovchenko VV, Popov SV, Popova Yu G, Paderin NM, Shashkov AS *et al*. Food Chem 2009;114:610-615.
7. Popov SV, Popova Yu G, Koval OA, Paderin NM, Ovodova RG, Ovodov Yu S. Phytother. Res 2007;21: 609-614.
8. Popov SV, Popova Yu G, Ovodova RG, Ovodov Yu S. Fitoterapia 2005;76:281-287.
9. Attele AS, Wu JA, Yuan CS. Biochem. Pharmacol 1999;58:1685-1693.

10. Chang YS, Seo EK, Gyllenhaal C, Block KI. Integrative Cancer Therapies 2003;2:13-33.
11. Choi KT. Acta Pharmacologica Sinica 2008;29:1109-1118.
12. Kim YS, Kang KS, Kim SI. Arch. Pharmacal Res 1990;13:330-337.
13. Shin HJ, Kim YS, Kwak YS, Song YB, Kim YS, Park JD. Planta Med 2004;70:1033-1038.
14. Yun YS, Lee YS, Jo SK, Jung IS. Planta Med 1993;59:521-524.
15. Konno C, Sugiyama K, Kano M, Takahashi M, Hikino H. Planta Med 1984;50:434-436.
16. Suzuki Y, Hiking H. Photother Research 1989;3:15-19.
17. Kiyoyaha H, Hirano M, Wen XG, Matsumoto T, Sun XB, Yamada H. Carbohydr. Res 1994;263:89-101.
18. Kim HJ, Kim MH, Byon YY, Park JW, Jee Y, Joo HG. Journal of Veterinary Science 2007;8:39-44.
19. Song JY, Han SK, Bae KG, Lim DS, Son SJ, Jung IS *et al*. Radiat. Res 2003;159:768-774.
20. Popov SV, Ovodova RG, Golovchenko VV, Popova Yu G, Viatyasev FV, Shashkov AS *et al*. Food Chem 2011;124:309-315.
21. Patra P, Das D, Behera B, Maiti TK, Islam SS. Carbohydr. Polym 2012;87:2169-2175.
22. Patra P, Sen IK, Bhanja SK, Nandi AK, Samanta S, Das D *et al*. Carbohydr. Polym 2013;92(1):345-352.
23. Wang JH, Luo JP, Zha XQ. Carbohydr. Polym 2010;81:1-7.
24. Sun Y, Cui WS, Tang J, Gu X. Carbohydr. Polym 2010;80:544-550.
25. Sun L, Ropartz D, Cui L, Shi H, Ralet MC, Zhou Y. Carbohydrate Polymers 2018;203:119-127.
26. Fan YY, Cheng HR, Liu D. Arch Pharmacol Res 2010;33:681-689.
27. Wang J, Li SS, Fan YY. J Ethnopharmacol 2010;130:421-423.
28. Cheng HR, Li SS, Fan YY. Med Oncol 2010;28:175-181.