

# Non-Amidated Low Methoxyl Pectin

## Supplemental Report

### Identification of Petitioned Substance

**Chemical Name:** Pectin

**Non-Amidated**

**CAS Number:** 9000-69-5

**Low Methoxyl Pectin**

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**Other Names: Common Name Pectin**

**Other Codes:** INS No. 440

Apple Pomace, Citrus Pomace

Citrus Peels

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Modified Citrus Pectin, Pectinic Powder

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**Trade Names:** Pectin

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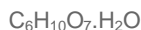
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### Supplemental Information

The following supplemental information is provided in response to following question. "What is the scientific and molecular difference between high methoxyl and low methoxyl pectin (not addressed in previous Technical report)? The petition indicated that methoxylation is a function of time."

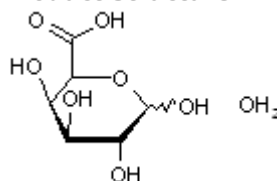
The term pectic substances is often used to describe pectin since the structure is very complex and essentially no two pectins have identical structures. Chemically, pectin is a linear polysaccharide containing 300 to 1,000 monosaccharide units which has a molecular weight of 50,000 to 150,000 Daltons. D-Galacturonic acid is the principal monosaccharide unit of pectin.

#### Chemical Structure for D-Galacturonic Acid



Molecular Weight: 212.15

#### **Product Structure**

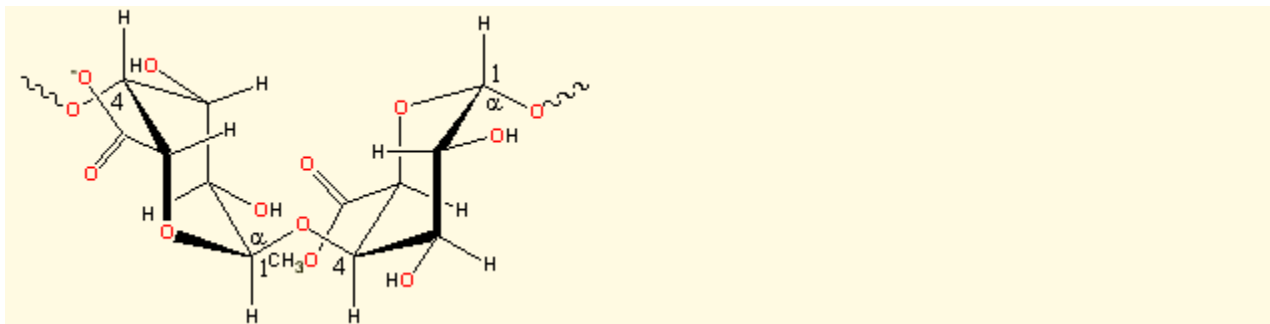


The D-galacturonic acid residues are linked together by alpha-1, 4 glycosidic linkages. Pectic substances are commonly used to encompass pectin, pectic acid and its salts (pectates), and certain neutral polysaccharides (arabinan, arabinogalactan, and galactan). Pectic acids or pectates are de-esterified pectins.

The galacturonic acid residues in pectin may be esterified with methyl groups.

#### **Pectin structural unit**

Pectin has a complex structure with an  $\alpha$ -(1 $\rightarrow$ 4)-linked D-galacturonic acid polysaccharide backbone. Preparations consist of sub-structural entities that depend on their source and extraction methodology. Commercial extraction causes extensive degradation of the neutral sugar-containing sidechains.

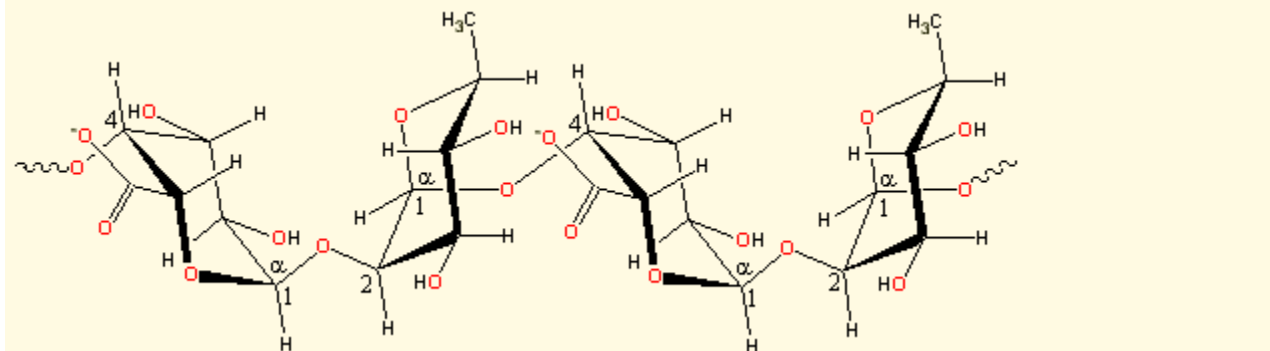


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43 **Figure 1**

44 The majority of the structure consists of homopolymeric partially methylated poly- $\alpha$ -(1 $\rightarrow$ 4)-D-galacturonic acid  
 45 residues ('smooth', see Methyl group(CH<sub>3</sub>) at bottom center of figure 1 Above) but there are substantial 'hairy' non-  
 46 gelling areas (see  $\alpha$  1-2 bottom center of figure 2 below ) of alternating  $\alpha$  -(1 $\rightarrow$ 2)-L-rhamnosyl- $\alpha$  -(1 $\rightarrow$ 4)-D-  
 47 galacturonosyl sections containing branch-points with mostly neutral side chains (1 - 20 residues) of mainly L-  
 48 arabinose and D-galactose (rhamnogalacturonan I).

49 Pectins may also contain rhamnogalacturonan II side chains containing other residues such as D-xylose, L-fructose,  
 50 D-galacturonic acid, D-apiose, 3-deoxy-D-manno-2-octulosonic acid (Kdo) and 3-deoxy-D-lyxo-2-heptulosonic acid  
 51 (Dha) attached to poly- $\alpha$ -(1 $\rightarrow$ 4)-D-galacturonic acid regions.



52

53 **Figure 2**

54 Methylation occurs at carboxyl groups of Gal A residues. The degree of methyl-esterification is defined as the  
 55 percentage of carboxyl groups (Gal A residues) esterified with methanol. Pectin in which more than 50% of the  
 56 galacturonic acid residues are esterified is called high methoxyl or HM pectin. Pectin in which less than 50% of the  
 57 galacturonic acid residues are esterified is called low methoxyl or LM pectin. Most of the natural pectins are HM with  
 58 a few exceptions such as sunflower pectin. The degree of acetylation (Dac) is defined as the percentage of Gal A  
 59 residues esterified with one acetyl group. It is assumed that only the hydroxyl groups are acetylated. Since each Gal A  
 60 residue has more than one hydroxyl group, the Dac can be above 100%. Dac is generally low in native pectin except  
 61 for some such as sugar beet pectin.  
 62

63 Pectin is classified as a soluble fiber. It is found in most plants, but is most concentrated in citrus fruits (oranges,  
 64 lemons, grapefruits) and apples. Pectin is obtained by the aqueous extraction of citrus peels and apple pulp under  
 65 mildly acidic conditions. Pectin obtained from citrus peels is referred to as citrus pectin. So-called modified citrus  
 66 pectin is pectin that has been hydrolyzed and otherwise modified to make it more digestible and absorbable.  
 67

68 Pectin is a carbohydrate in the cell wall of plants. It is a breakdown product from hemicelluloses (protopectins) which  
 69 is generated during ripening of the fruit. Pectin itself is later broken down to pectinic acid and finally pectic acid.  
 70 During this chemical breakdown process, the fruit gets softer as the cell walls degenerate. Pectin is a "gum" found  
 71 naturally in fruits that causes jelly to gel. Tart apples, crab apples, sour plums, Concord grapes, quinces, gooseberries,  
 72 red currants and cranberries are especially high in pectin. Apricots, blueberries, cherries, peaches, pineapple, rhubarb  
 73 and strawberries are low in pectin. Under ripe fruit has more pectin than fully ripe fruit. Pectin is widely used in the  
 74 food industry as a gelling agent to impart a gelled texture to foods, mainly fruit-based foods such as jams and jellies. It  
 75 also has pharmaceutical applications. Pectin is used in combination with the clay kaolin (hydrated aluminum silicate)  
 76 for the management of diarrhea. It is used as a component in the adhesive part of ostomy rings. Pectin is also marketed  
 77 as a nutritional supplement for the management of elevated cholesterol. Rhamnose, galactose, arabinose, and xylose

78 are the most common neutral sugar components of pectins. The less common ones are glucose, mannose, and fructose.  
79 Some of the xylose residues are individually attached to galacturonic acid (Gal A) residues at O-3 position. Three  
80 types of neutral sugar side chains have been identified in pectins. Arabinan consists of 1-5 linked arabinose.  
81 Arabinogalactan I consists of 1-4 linked galactose with short arabinan chains attached at O-3 position. In  
82 arabinogalactan II, galactose is 1-3&6 linked with arabinose attached.

83  
84 Pectin may contain some non-sugar components. Ferulic acid esters have been found in sugar beet pectin. They are  
85 linked to the arabinose and galactose residues in the neutral sugar side chains.

86  
87 As a result of the differences in the composition of pectin and different types and sources of pectin, the molecular  
88 weight will usually be given as a range such as listed above (50,000 to 150,000 Daltons). In other instances, high  
89 molecular weight, low methoxyl pectins have been patented which have a degree of methylation of 10 percent (%) or  
90 less and an average molecular weight greater than  $1.0 \times 10^6$  (1,000,000) Daltons.

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92 The specific molecular structure of a given pectin depends on the substance's, source, degree of esterification and  
93 methylation (HM or LM), and whether the pectin is amidated or non-amidated. This information should be available  
94 from pectin suppliers or processors.

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