Frequently asked question

1. Write a brief note on history of pectin.

The word 'pectin' derived from Greek, it means 'congealed (semi solid). It has been recognized for at least 200 years and was originally identified in 1790 in apples by the French chemist Nicholas Vauquelin (who also discovered the elements chromium and beryllium). Until 1984 there were no further reports available on pectins and later the scientist, Braconnot was undertaken. He has named the acid, gelling substance pectic acid after the Greek word for gelling or congealing. Further, Smolenski identified the gelling substance as a polymer of galacturonic acid and later on, in 1937 Schneider and Bock established the basic formula of pectin.

2. What is pectin? Explain with its chemical composition.

Pectin's are the mixtures of polysaccharides, which is found as a major component of cell walls in all plants particularly apples or citrus fruits. Pectin's are complex heteropolysaccharide composed primarily of essentially linear polymers of -Dgalactopyranosyluronic acid units linked through 4) glycosidic linkages; the polymer chains are esterified to various degrees with methanol. This regular structure is interrupted, however, with L-rhamnopyranosyl units and with side chains containing other neutral sugars. The polymer chains may also be partially acetylated. The most important physical property of pectin is its ability to form spreadable gels. Gel formation results when the polymer chains interact over a portion of their length to form a three-dimensional network. This aggregation of chains occurs through hydrogen bonding, divalent cation cross bridging, and/or hydrophobic interactions. Pectin contains pectinic acids as major components, water soluble, and able to form gels under appropriate conditions.

3. What are the sources of pectin?

Presently, the traditional, commercial sources of pectin have been majorly extracted from citrus peel and apple pomace, which are by-products of juice manufacturing units. Apple pomace contains 10-15% of pectin's, whereas citrus peel contains relatively higher i.e., 20-30% of pectin's. More recently other sources of pectins are beginning to search for market include sugar beet waste from sugar manufacturing, sunflower heads (seeds used for edible oil), and mango waste.

Also, crab-apples, gooseberries, some type of plums, high bush cranberries, strawberries, cherries, blueberries and papaya contains little percentage of pectin's.

4. Explain the difference between high methoxy gelation and low methoxy gelation.

High methoxy gelation pectin usually forms at a pH of below 3.5 and total solids content of above 55%. This type of gel formed during jam making and high methoxy pectins are characterised by their setting time and the gel strength. Setting time is usually categorized as rapid set, medium set and slow set. High methoxy pectins gel slower as more of the methoxy groups are removed during processing.

Low methoxy pectin is gelled with calcium ions and hence is not dependant on the presence of acid or high solids content. The low methoxy pectin has the lowest level of esterification and amidation can interfere with the gelation causing the gelation to be delayed. Another useful property of amidated pectins is the ability of the gel to reheal after shearing.

5. How was the solubility of pectin with solvent water? Explain

Monovalent cation salts of pectinic and pectic acids are usually soluble in water; di- and trivalent cations salts are weakly soluble or insoluble. Dry powdered pectin, when added to water, has a tendency to hydrate very rapidly, forming clumps. These clumps consist of semidry packets of pectin contained in an envelope of highly hydrated outer coating. Clump formation can be prevented by dry mixing pectin powder with water-soluble carrier material or by the use of pectin having improved dispersibility through special treatment during manufacturing.

6. What are the difference between Native and commercial pectins.

native pectins:

Native pectin is composed of three major polysaccharides, all containing α (1 \rightarrow 4)-D-galacturonic acid residues; usually referred as galacturonans. These are homogalacturonan, rhamnogalacturonan- \Box , and rhamnogalacturonan-II.

Homogalacturonan is a linear chain of α (1 \rightarrow 4)-D-galacturonic acid residue with a variable degree of methyl esterification at the carboxyl group. It could be *O*-acetylated at C-2 or C-3 depending on the source

Rhamnogalacturonan-I consists of repeating units of the disaccharide α (1 \rightarrow 2)-Lrhamnose- α (1 \rightarrow 4)-D-galacturonic acid. Galacturonic acid residues can be *O*acetylated at the C-2 or C-3, while 20-80% of the rhamnose residues can be substituted at C-4 or C-3 with neutral sugar side chains. The composition of the neutral sugars varies among plant sources as D-galactose, L-arabinose, and Dxylose being the most common. Other neutral sugars such as D-glucose, Dmannose, L-fucose, and D-glucuronic acid are found less frequently.

Rhamnogalacturonan-II, represents its misleading identification, has a backbone of α (1 \rightarrow 4)-D-galacturonic acid. Some of the side chains attached to the backbone have been identified as 2-keto-3-deoxy-D-manno-octulosonic acid, 3-deoxy-D-lyxo-2- heptulosaric acid, apiose, and aceric acid. All neutral sugars are located in side chains are rhamnogalacturonan I and II domains, and therefore, these domains are often referred as "hairy regions".

In addition to the above three major domains, arabinogalactans, arabinans, and xylogalacturonans are also found in native pectin, all lacking the galacturonan backbone.

commercial pectins:

Commercial pectins are structurally less complex due to the industrial extraction and purification process, which remove most of the neutral sugars. These consist mainly, a backbone of α (1 \rightarrow 4)-D-galacturonic acid with partial methyl esterification of the carboxyl groups. At least 65% of the extracted material must be galacturonic acid, in order for extracted material to be classified as commercial pectin.

7. Give a note on high methoxy and low methoxy pectin with their uses.

• Rapid Set pectin is a high-methoxyl form of the substance, meaning it contains high quantities of the compound CH_3O . It is most often used in preserves that contain bits of fruit or vegetable, such as jams and marmalades.

• Slow set pectin, another high-methoxyl form of pectin, is used in less pulpladen jellies, such as apricot and grape jelly. It's also used in some less pulpy jams and preserves.

• Stabilizing pectins are most commonly used in dairy products. Specifically, they are used to stabilize acidic proteins in dairy products during any heat processing used to manufacture the product. Stabilizing pectins can be found in yogurt, soya beverages and whey beverages.

• Low methoxyl pectin, also known as LM pectin, is often used for products with reduced sugar content. This form of pectin needs calcium as a catalyst to begin the gelling process. Products containing LM pectin include reduced sugar preserves, sauces, marinades and dessert toppings. LM pectin is also used in low acid fruit preserves, such as fig preserves.

8. What is the composition of apple pomace?

Apple pomace approximately accounts 25- 35% (w/w) of the fresh apple fruits that are processed. Apple pomace is mainly composed of carbohydrates, fibers, proteins, and small quantities of minerals and considered a rich source of dietary fiber, especially pectin with 10-15% content (w/w dry basis).

9. How to extract pictins? Explain through flowchart.



10. Mention the general applications of pictins.

Depending on the chemical characteristics of pectin, it is used in numerous food applications as a gelling agent, thickener, stabilizer, and emulsifier.

The traditional application of pectin is as a gelling agent in a wide range of fruitbased products like jams, marmalades, jellies, fruit preparations for yoghurts and desserts and fruit filling for bakery products. It can be used to improve the mouthfeel and the pulp stability in juice based drinks and as a stabilizer in acidic protein beverages. And also reduces syneresis in jams and marmalades and increases the gel strength of low calorie jams.

Besides its use in the food industry, over the past few decades' pectin is also used in pharmaceutical and cosmetic products. Various properties of pectin, such as gelling, emulsifying, and film forming abilities, in addition to its resistance to degradation in the upper gastro intestinal tract, has allowed the increasing use of pectin in the development of drug delivery systems through encapsulation.

11. How Pectin is used in the encapsulation of unstable food ingredients?

1. High methylated pectin's are used in jams and jellies. The role of the pectin is to impart a gel texture to the jam or jelly. This texture must be strong enough to allow transportation and storage without changes. It is mainly used for fruit flavored products, where the acidity enhances most fruit flavors. The pectin is used within the confectionery industry for making fruit jellies, jelly centre's, and wine gums. In wine gum formulations it is often combined with gelatin. It is also used for aerated products together with whipping agents.

2. Stabilization of protein containing drinks with pH around 4 is an increasingly an important application area for pectin. Types of drinks like yoghurt drinks, milk-juice drinks, acidified whey drinks, and acidified soya drinks.

3. Pectin is used for fat replacement in low-fat spreads and butter spreads. In these products, it binds water and thereby improves the emulsion stability. A pectin type, SLENDID[®], has been developed to mimic a fat-like mouth feel.

4. Pectin is used in fruit-milk desserts, where the interaction with calcium is utilized to obtain an instant gelation when adding calcium ions (milk) to syrup containing pectin. In milk desserts, LMA pectin is incorporated to provide texture and mouth feel, often in combination with other stabilizers

5. α -tocopherol, which is the most abundant and active form of vitamin E, is commonly used by the food industry for food fortification and to inhibit lipid oxidation. However, the use of α -tocopherol is, sometimes, hindered by its sensitivity to heat, oxygen, and light, and high hydrophobicity. So, pectin could be used as an ingredient in the development of a polymeric matrix for the encapsulation of α -tocopherol, to provide protection, enhance the stability, and to deliver α -tocopherol under specific conditions, or gastrointestinal environments.

12. How pectin is used in the pharmaceutical and cosmetic process?

1. Pectin has multiple beneficial effects on human health including lowering of blood cholesterol and serum glucose levels and the potential inhibition of cancer growth and metastasis. Some of these benefits may occur via the induction of apoptosis (programmed cell death) and/or the interfering with ligand: receptor interactions

2. Irritable bowel syndrome, a functional gastrointestinal disorder can be reduced by fiber diet means through pectin. In fact, one of the leading medications for this problem, Kaopectate®, used pectin as one its main "active" ingredients. Here Pectin acts as thickening agent and also found in other medicines such as Luden's® (Cough syrups).

3. Orange peel pectin shows good potency as a binding agent.

4. The properties of pectin are utilized in a variety of personal care applications, including skin- and hair-care products and color cosmetics. Apart from providing structure in formulated products, pectin can form a gel on the skin.

5. The viscosity of pectin solutions is utilized to evenly distribute and provide non-slimy spreadability of hair conditioners and hair styling products.

13. write a note Sources of pectins:

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Categories of pectin: the gelation property of pectins can be divided into two main categories: high methoxy gelation and low methoxy gelation.

14. write a note Classification of pictins

chemical structure and composition of pectin's are studied by classifying them into native and commercial pectins.

Pectin's are subdivided according to their degree of esterification (de), a designation of the percent of carboxyl groups esterified with methanol. Pectin's with de > 50 are high-methoxyl pectins (hm-pectins); those with de < 50% are low-methoxyl pectins (lm-pectins).

Apple pomace : the processing of apple fruits for juice and cider making results in large amounts of solid byproducts, which are termed "apple pomace".

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