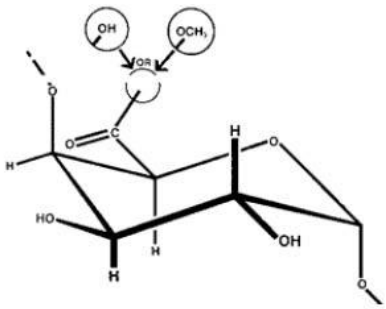
Abstract for Pectin production from fruit pulps

1. What is Pectin?

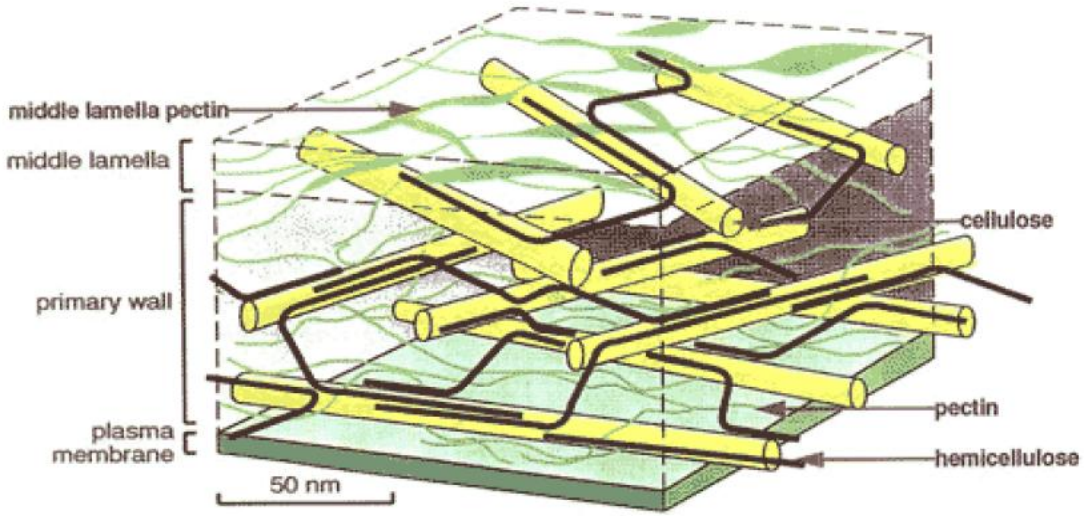
Pectin for use in food is defined as a polymer containing galacturonic acid units (at least 65%). The acid groups may either be free, combined as a methyl ester, or as sodium, potassium, calcium or ammonium salts, and in some pectins amide groups may also be present.

Pectin in the plant starting material is part of a very complex structure, which gives shape to the soft non-woody parts of the plant. Plant cell wall structure diagram Pectin in this state contains a range of neutral sugar molecules, in a complex non-random structure, containing blocks of homogalacturonic acid (sometimes called "smooth regions"), and blocks containing many neutral sugar molecules (rhamnose, galactose, arabinose, and lesser amounts of other sugars) in a highly branched structure (sometimes referred to as "hairy regions").



Galacturonic Acid Unit

When pectin is extracted, much of the hairy regions are destroyed, leaving mainly the smooth galacturonic acid regions, with a few neutral sugar units attached or in the main linear chain. The nature and placing of these neutral sugars may vary with the source material, and have some influence on the properties of pectins from different origins. However, the biggest influence on



Pectin properties is the degree of esterification (DE), which determines, for example, the degree of reactivity with calcium and other cations.

2. Discovery & History

Jams and Jellies have been produced for many years, at least since the 18th Century. Recipes were published in the "London Housewife's Family Companion" of 1750 which described jellies made from apple, currant, and quince, all fruits rich in gelling pectin. Pectin was first isolated in the 1820s, and shown to be the key to making jams and jellies. Gradually, people mixed pectin rich fruits or fruit extracts with fruits which do not set jams well - strawberry
with gooseberry or with red currant, for example. Extracts of apple peels and cores were also used for "difficult to set" jams.

Commercial jam producers sought further supplies of pectin source materials. In

Germany, apple juice producers started to dry the pomace residue left after pressing juice for sale to jam makers, who would cook the pomace in water with or without fruit juice to make a jellying juice. The first commercial production of a liquid pectin extract was recorded in 1908 in Germany, and the process spread rapidly to the United States, where a classic patent was obtained by Douglas (US Pat. 1.082,682, 1913). This was followed by a rapid growth of the pectin industry in the United States, and also somewhat later in Europe.

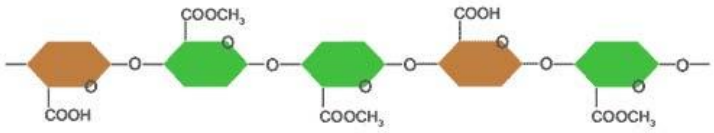
In recent years, the centre of production has moved to Europe and to citrus-producing countries like Mexico and Brazil.

Further changes of structure and location of the industry continue, but are constrained by the need for large capital investment to set up a plant of economic size, and the need for a large-scale source or sources of raw material.

3. Types of Pectin

Pectin as extracted normally has more than 50% of the acid units esterified, and is classified as "high methyl ester (HM) pectin".

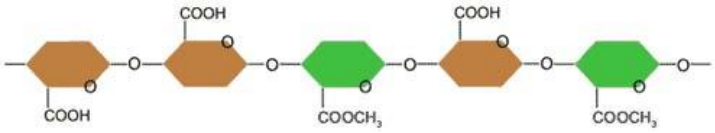
HM pectin formula



The percentage of ester groups is called degree of esterification. High methyl ester pectins are classified in groups according to their gelling temperature as rapid set to slow set pectins (see application of pectins).

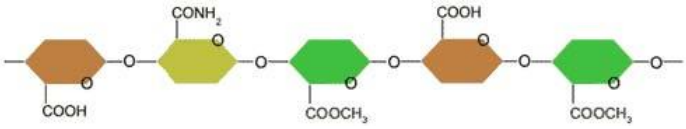
Modification of the extraction process, or continued acid treatment, will yield a "low methyl ester LM) pectin" with less than 50% methyl ester groups.

LM pectin formula



Some pectins are treated during manufacture with ammonia to produce amidated pectins, which have particular advantages in some applications.

Amidated pectin formula



Within each of these main types, there are many detailed variations prepared for different uses.

The structure of pectin molecules is the key to the properties of pectins, and their use in different applications.

- Pectin molecules are long, and easily entangle with each other, causing thickening

  Pectin can improve the texture of low sugar drinks.

- If enough sugar is added to reduce the availability of water to dissolve pectin molecules fully, the molecules stick together in smooth regions with ester groups to form a gel network.

  Conventional high sugar jams depend on pectin to set, and also require a minimum sugar content.

- Because the acid groups are relatively weak, changes in the acidity (pH) alter the amount of charge on the pectin chains. Pectins which can link together under acid conditions have enough charge at lower acidity (higher pH) to repel each other.

  This explains why it needs both sugar and acid to set a jam or jelly.

- The acid groups in pectins can react with calcium ions which have two positive charges, and can link two acid anion groups with negative charges. If enough negative groups occur together, as in low ester pectins, these can link pectin molecules together in a gel network without needing so much sugar

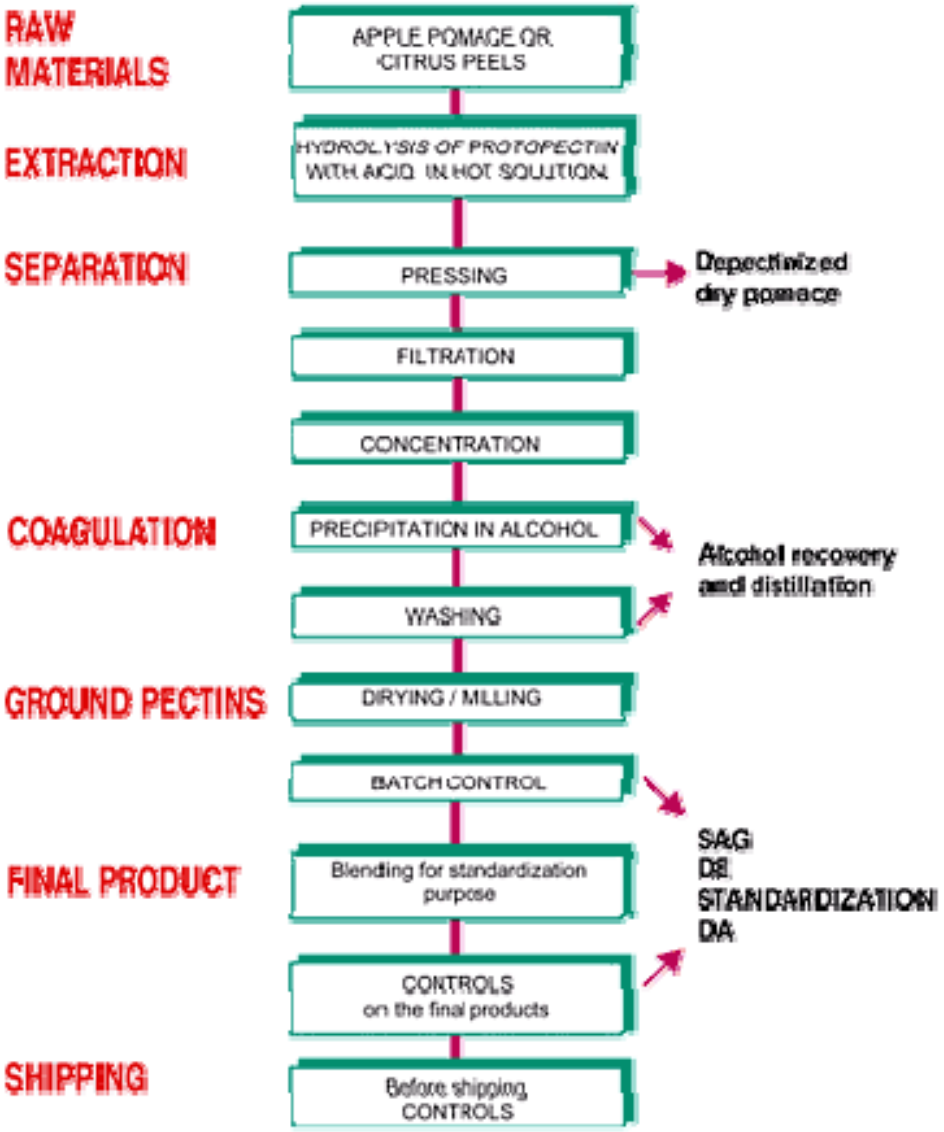
  Low ester pectins are used to make low sugar jams, and many different fruit preparations for use in the food industry.

- Pectin molecules with a negative charge can bind to proteins carrying a positive charge and prevent them coagulating when heated.

  Pectins can stop the milk protein in yoghurt from curdling with heat, so heat treated (UHT) long life yoghurt drinks can be made.

4. Commercial Production

Process details vary between different companies, but the general process is as follows:



5.Applications of Pectins

Pectin is one of the most versatile stabilizers available. Its gelling, thickening and stabilizing attributes makes is an essential additive in the production of many food products.

Traditionally, pectin was primarily used in the production of jams and fruit jellies - industrially as well as domestically and in low as well as high sugar products. It secures the desired texture, limits the creation of water/juice on top of the surface as well as an even distribution of fruit in the product. With the change in lifestyle pectin is primarily sold for industrial use. In some European markets it is still sold to the consumers as an integrated component in *gelling sugar*, though.

Product and application development by the major pectin producers has over the years resulted in a large expansion of the opportunities and applicability of pectin. Pectin is a key stabilizer in many food products

- **Fruit applications**
  - **Jams, jellies, and desserts**
- **Bakery fillings and toppings**
  - **Fruit preparations for dairy applications**
- **Dairy applications**
  - **Acidified milk and protein drinks**
  - **Yoghurts (thickening)**
- **Confectionery**
  - **Fruit jellies**
  - **Neutral jellies**
- **Beverages**
- **Nutritional and Health Products**
- **Pharmaceutical and Medical Applications**

Over the years the positive public connotation of pectin has proven helpful in its widespread use, and this may be a contributing factor to the growing interest in investigating pectin for possible direct health benefits and thus applications in regulated non-food segment as well as in functional foods and nutraceuticals. Pectins

also find medical and pharmaceutical applications.

This wide range of applications explains the need for many different types of commercial pectins, which are sold according to their application, for example:

- Rapid Set pectin - traditionally used for jams and marmalades
- Slow Set Pectin - used for jellies and for some jams and preserves, especially using vacuum cooking at lower temperatures. Also important for higher sugar products like bakery and biscuit jams, sugar confectionery, etc.
- Stabilising Pectins - used for stabilising acidic protein products such as yoghurts, whey and soya drinks against heat processing.
- Low methyl ester and amidated pectins - used in a wide range of lower sugar products, reduced sugar preserves, fruit preparations for yoghurts, dessert gels and toppings, and savoury applications such as sauces and marinades. Can also be used in low acid high sugar products such as preserves containing low acid fruits (figs, bananas) and confectionery.

Full report is available with following contents: