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Know-How and Experience

SWISS QUALITY

VIDOPECTINE®

Jams, Jellies, Marmalades and Preserves

From early civilization, people preserved seasonal fruits by just cooking them or together with some form of sugar. Cooking destroys the fruit's enzymes and also reduces the water activity if enough water is boiled out, inhibiting the growth of spoilage organisms such as yeasts and moulds. The heating helps the preservation and also serves to extract the naturally occurring pectin (usually this is high methoxyl pectin) in the fruit. With the sugar present in the system and helped by the fruits own acidity, the natural and now activated pectin will thicken or gel the product. This age-old process is the basis of all present-day large-scale jam making, but modern technology also plays a considerable role.

To this day, jams, jellies and marmalade remain some of the most popular and convenient food products for consumers. Pectin has long been used to provide stability, extended shelf-life and texture to a wide range of these products. Today, commercially produced pectins are applied to compensate for the deficiency from the fruit and to make sure the jam manufacturing process runs smoothly and continuously, the finished products are of consistent quality, excellent stability and the required texture. Also, specially developed and produced pectin types like, e.g. low methoxyl pectins are widely used to gel systems where the sugar content or the acidity is too small for high methoxyl pectins to be effective.

To appreciate the role and application of pectins in jams, jellies, marmalades and preserves, it is useful to familiarize ourselves to a few terms which describe and characterize them.

HM (high methoxyl) and LM (low methoxyl) pectins

Naturally occurring pectin is almost always of HM variety, with LM pectin types typically being made from these by de-esterification treatment under acidic conditions. HM pectins can form gels with sugar only at high soluble solids levels of more than approx. 55%. LM pectins can also form low solids (low sugar) gels, and to do that they need a controlled level of certain di- or polyvalent cations, of which calcium and potassium are the ones used in the food industry.

LM amidated pectins

They are produced by the de-esterification of HM pectin in the presence of ammonia. In most situations, they behave in a very similar way to LM pectins. However, they do show specific differences in the way they react with, e.g. calcium that sometimes makes them easier to use than non-amidated LM pectins.

Gel strength & standardization

The gel strength of pectin is a measure of the ability of that pectin to form a gel under standard laboratory conditions. For HM pectins, normally the USA-SAG or IFT method is used, and standardization of the pure and fluctuating HM pectin, to a constant gel strength, is done by dilution with sugar to 150 or 200 Grade (150 USA SAG or 200 USA SAG).

LM pectins are used under a much wider range of conditions like sugar contents and pH values, and there is less uniformity in the standardization methods which are applied, but usually, they are characterized by their calcium reactivity and gel strength under standardized conditions.

Setting Temperature, Setting time

HM pectins for the use in Jam, Jellies and Marmalades are classified either by Setting Temperature or by Setting Time. Setting Temperature is the temperature at which setting starts, and the setting temperature is the time between the pouring of a hot jelly mix and occurrence of setting. Both of these are measured under precise laboratory conditions and must not be confused with production setting rates. Neither parameter is typically specified for any LM pectin.

Pectin manufacturers might prefer one method over the other. Usually, the two ways do correlate regarding the classification of the HM pectins into Extra Rapid Set, Rapid Set, Medium Rapid Set, Slow Set and Extra Slow Set pectins.

Extra Rapid Set, Rapid Set, Medium Rapid Set, Slow Set, Extra Slow Set pectins

These descriptions classify only HM pectins. Those showing the highest Setting Temperature (and shortest Setting Time) are known as Extra Rapid Set. At the same time, progressive acid treatment lowers the degree of esterification (the number of ester groups on the pectin backbone). It brings down the Setting Temperature of the pectin (Setting Time increases) until Slow Set pectin is reached.

Jam production methods

Most preserves are made with one of two general types of equipment, with many variations possible to each.

Open pan (atmospheric) cooking

It is the traditional method of jam production, in which water is evaporated by boiling the recipe ingredients in a heated pan. Heating usually is indirect by steam, and the process is batch rather than continuous.

Vacuum cooking

Cooking the ingredients under vacuum can be done at a lower temperature because of the lower boiling point. This faster process helps to reduce degradation of the pectin (both added and naturally occurring from the fruit), gives better colour and flavour retention of the fruit, minimizes the caramelization of the sugar and makes a more appealing and fruitier tasting product. Indirect steam heating is most frequently used, and besides the mostly used vacuum kettles (batch process) there are other vacuum evaporation systems commonly found, such as Plate Evaporators and Scraped Surface Evaporators, which are continuous systems. These, however, are restricted to products without large fruit pieces.

Jam product types

Most products in the jam, jellies, marmalades and preserves market segment can be placed into one of the following main groups:

- Traditional, conventional, household or foodservice market
- Bakery and Industrial Jams
- Low sugar, reduced sugar, no added sugar jams, diet jams

Traditional, conventional, household or foodservice market:

These are the traditional and essentially self-preserving jams, jellies and marmalades usually with more than 62% soluble solids or °Bx, measured by refractometer. They typically have legal requirements regards to fruit and sugar content and are sold as consumer products or in larger packs for foodservice and catering use.

Pectin dosage:
The added commercial pectin in these products is only needed to supplement the pectin which comes from the fruit itself, the quantity required, therefore, will largely depend upon the variety, and amount of the fruit used.
For a jam of 62% soluble solids and a pH of 3.2, using 45% of whole or pulped fruit, the dosage of a 150 USA-SAG pectin would be in the range of 0.2 – 0.40%. For jellies made with fruit juice, the addition rate would be 25-50% higher than the above for fresh juice and even more for de-pectinized juice. Other factors affecting the pectin dosage are the type of fruit (like e.g. pectin rich fruits like apples or oranges, softer fruits like strawberries or raspberries, the firmness and texture of the jam required, final soluble solids/°Bx, pH, cooking time, container size and others.

Pectin type:
High methoxyl Rapid Set or Medium Rapid Set pectins would be the choice for these conventional jam products except when

- Filling into large containers like, e.g. buckets at lower temperatures to prevent centre burning
- Filling into portion control packs or needing a longer time to fill the batch into containers.
- Making jelly and preventing air bubbles from getting gelled into the product.
- Using fruit with very fast setting pectin (like e.g. some citrus fruits, apricots etc.)
- Using other soluble solids than sucrose, which can have a strong influence on the setting temperature of the system (like sorbitol, fructose, glucose syrup or HFCS).

Product and processing parameters (pH, soluble solids content and type of sugars, filling temperature):

- pH-value:
  Inadequate pH control is the main reason for sub-standard results. To achieve optimum performance and consistent quality, the pH must be correct both in the finished product and at all stages of the production process. Pre-gelation, syneresis and the floating of fruit are common signs of an incorrect pH. Acid is normally added at the end of the cooking process and when the final soluble solids content has been reached. The optimum product pH is product specific and a function of pectin type, soluble solids and sugars used. A higher soluble solids content (e.g. 70 Bx) and/or lower pH (e.g. 2.8 instead of 3.0) of the jam makes each HM pectin gel faster and at higher temperatures. So to prevent pre-gelation, it is advisable to switch to a slower setting type (e.g. using Slow Set instead of Medium Rapid Set pectin).
- Sugars, soluble solids:
  Poor control of soluble solids can result in inconsistent texture and gel strength as well as syneresis. The soluble solids content of the preserve can be measured quickly and easily using a refractometer during production. A lower than typical solids content leads to softer gels and vice versa.

- **T**ype of sugar:
  Today it has become industry standard to replace sucrose with other sugars partially or even entirely for reasons of cost, product taste and texture. 42 and 63 DE corn syrup and high fructose corn syrup (HFCS with about 45% fructose) are the most commonly used. These sugars can make the gel weaker, raise the optimum pH for gelation and increase the setting temperature, the effects can be quite strong, and it is difficult to define generally valid guidelines.
- Filling Temperature:
  It is crucial to control the temperature at which filling takes place. For containers up to 1,000g, 80-88°C are seen as ideal even for jellies, where setting may happen at much lower temperatures. Filling at higher temperatures, while better from a pasteurization point of view, quickly causes problems with caramelization, floating fruit, centre burning, even pectin degradation. In comparison, at lower fill temperatures, there are risks of pre-gelation and microbiological spoilage. As a rule, a lower pH will produce a higher setting temperature, and a higher pH a lower setting temperature. The setting temperature of high methoxyl pectin is dependent on the cooling rate of the gel, and very rapid cooling can be used to allow a lower product filling temperature, e.g. when filling larger containers like buckets or drums.

Start point recipe:

Ingredients	% by weight
Fruit	45.00
Sugar	37.00
Glucose syrup (42DE), 80%ss	25.00
VIDOPECTINE MRSC 150 (5% soln.)	4.00-7.00 (0.2 – 0.35% pectin)
Citric acid (50% w/v soln.)	to pH 3.0 – 3.2

Brix: 62

Procedure:

- Prepare pectin solution using hot water (85°C) and high-speed mixer. Add 5 g pectin to 95 g of water, making a 5% solution.
- Heat fruit, sugar and glucose syrup in a kettle to boiling point.
- Add pectin solution (40 – 70 g depending on required gel strength) to batch.
- Cook to final Brix (62 Bx).
- Add the citric acid solution to adjust the pH, and check if correct.
- Cool to 80 - 85°C and fill into containers.
- Let cool without disturbance.

Bakery and Industrial Jams:

Products in this market segment are usually filled into larger containers like pails, drums, pallecons or containers. They can be divided into two main groups, as follows:

- Pre-bake jams with 65 – 72 Bx, deposited or spread onto pastry or dough before baking, with a bake-stability/form stability high enough withstanding baking temperatures of 180 - 220°C without excessive melting or boiling out. These jams usually are produced with HM Medium Rapid Set Pectin like VIDOPECTINE MRSA 150 (apple pectin) or MRSC 150 (citrus pectin) with the apple pectin MRSA 150 giving better processing stability (pumpability, spreadability and reversibility) than the citrus pectin. The use of these pectins in this application is the same as in regular jams and preserves except for a higher pectin level (0.6-0.75%) and a sometimes higher pH (3.2-3.3) for a less elastic and softer set and lower setting temperature as these jams are filled into the larger containers at lower temperatures of 70 - 75°C to prevent centre burning and caramelization. The use of glucose syrup is common in these products for cost and textural reasons.

- Post-bake jams and fillings with 65 – 75 Bx, depositing onto or injection into a pastry, cake, biscuits etc. after baking. Bake stability is not required here, but pump stability, reversibility, viscosity stability during pumping and minimum soaking into the pastry (caused by syneresis and damaged gel integrity). VIDOPECTIN Slow Set A 150 or C 150 are well suitable and usually used with a higher proportion of glucose syrup. Production processes and conditions are similar to those described for the first group above, and they are also traditionally filled into large containers or drums.

Other and much more specialized jams and jellies for industrial and mainly bakery applications like cake glazes (nappages), Jaffa cake fillings, Swiss roll fillings and others will be covered and explained in detail in the product application bulletin 'Bakery'.

Low sugar, reduced sugar jams, no added sugar jams, diet jams:

For jams and jellies of less than 55 Brix the HM, pectins are not suitable because there is not enough sugar to help the pectin gel, not even with a very low pH.
Here it is essential to use LM pectins.

Regulations and standards of identity for such low sugar or reduced sugar jams vary considerably from country to country. The underlying basic principles are the same for all these low sugar systems.

Pectin type and use rate:
Both LM conventional and LM amidated pectins are suitable, though amidated pectins are often preferred for their easier use and greater tolerance of variations in operating conditions.
As a rule, the more calcium reactive pectins from both these groups are recommended

- At the lower end of the soluble solids range (e.g. 30Bx).
- At higher pH values in the finished product (e.g. pH 3.5 – 3.8).
- When a faster setting or higher setting temperature is required (e.g. to prevent fruit flotation).
- At lower fruit contents.
- When levels of available calcium are little or no calcium can be or should be added.
- When a firmer and more elastic-brittle set is required.

The less calcium reactive pectins should be chosen when these conditions are reversed.

VIDOPECTINE LM types	Low calcium reactive	Medium calcium reactive	High calcium reactive	Very high calcium reactive
Amidated	FA 4580	FA 3550	FA 3065	FA 2750
Conventional	FC 4065	FC 3865	FC 3045	FA 2865

The fruit's natural pectin is high methoxyl and contributes little to the set of a jam with low sugar content and won't affect the quantity of the LM pectin needed. Although the exact use rate depends on the recipe, the used ingredients and texture of the product required, dosages of 0.5-0.9% are typical for amidated pectins and slightly higher for conventional LM pectins. LM pectin ideally is always added as a pectin solution.

<u>Start point recipe:</u>

Ingredients	% by weight
Fruit	45.00
Sugar	35.00
Water	10.00
Tri-calciumdicitrate	0.01 – 0.02
VIDOPECTINE FA 3065 (5% w/v soln.)	14.00 (= 0.70% pectin)
Citric acid (50% w/v soln.)	to pH 3.3 – 3.4
Brix: 40	

Procedure:

- Prepare pectin solution using hot water (85°C) and high-speed mixer. Add 10 g pectin to 190 g of water, making a 5% solution.
- Heat fruit, sugar, water and tri-calcium-di-citrate in a kettle to boiling point.
- Add pectin solution (140 g) to batch.
- Cook to final Brix (40 Bx).
- Add the citric acid solution to adjust the pH, and check if correct.
- Cool to 80 - 85°C and fill into containers.
- Let cool without disturbance.

Important processing considerations:
It is essential to operate with the correct ratio of pectin to calcium, but this is the available rather than the total calcium in the system. It cannot be measured analytically but needs preliminary trials to establish. Some systems like those with high fruit contents or using calcium-rich fruits will have sufficient available calcium; others require a separate addition.

Higher pH values and broader pH ranges are possible for LM pectin based jams than with HM based products, but pectin and calcium addition rates will always need precise control. The same applies to the soluble solids/Brix content, and the use of a refractometer is crucial.

Sugar substitutes like sorbitol, fructose etc. are permitted for use in diet jams, these sugars always have a significant effect on the pectin-calcium reactivity, and usually require a much high calcium addition than, e.g. sucrose.

So-called no added sugar or 100% fruit jams are made without the use of sucrose but with a high fruit content plus concentrated fruit juice and with a Brix of 50 or below and therefore require the use of LM pectin. The usually high level of fruit acids from the concentrate will render much of the natural calcium unavailable for gelation by sequestering it. Thus needs to be compensated for by using a more calcium reactive pectin or adding extra calcium in the form of a soluble salt such as calcium- lactate or chloride.

Pectin types for Jams, Jellies, Marmalades and Preserves

High Methoxyl pectins

VIDOPECTINE	*Description*	*Typical DM*	*Standard*	*Typical application*
RSA 150	Rapid set apple	72	150 +/- 5 USA-Sag Setting Time / Temp.	Jams, jellies, preserves,
RS 150	Rapid set citrus	72		
MRSA 150	Medium rapid set Apple	66	150 +/- 5 USA-Sag Setting Time / Temp.	Bakery Jams and Fillings
MRS 150	Medium rapid set Citrus	66		Jams, Jellies, Preserves
Slow Set A 150	Slow set Apple	62	150 +/- 5 USA-Sag Setting Time / Temp.	Jellies, preserves, food service jams, portion control packs
Slow Set 150	Slow set Citrus	62		
ESSA 150	Extra slow set	56	150 +/- 5 USA-Sag Setting Time / Temp.	Jellies, food service jams, portion control packs
ESS 150	Extra slow set	56		

Low Methoxyl pectins

VIDOPECTINE	*Description*	*Typical DM*	*Standard*	*Typical application*
FC 4555	LM conventional pectin, very low calcium reactivity	45	Calcium reactivity and gel strength	Sugar reduced, low sugar jams, diet jams. Yogurt fruit preparations. Baking stable jams. Injection jams Ice ripples etc.
FC 4055	LM conventional pectin, low calcium reactivity	40		
FC 3865	LM conventional pectin, medium calcium reactivity	37		
FC 3045	LM conventional pectin, high calcium reactivity	34		
FC 2865	LM conventional pectin, very high calcium reactivity	30		

Low Methoxyl Amidated pectins

VIDOPECTINE	*Description*	*Typical DA*	*Standard*	*Typical application*
FA 4580	LM amidated pectin, citrus, low calcium reactive	10	Calcium reactivity and gel strength	Sugar reduced, low sugar jams, diet jams. Yogurt fruit preparations. Baking stable jams. Injection jams Ice ripples etc.
FA 3550	LM amidated pectin, citrus, medium calcium reactive	15		
FA 3065	LM amidated pectin, citrus, high calcium reactive	18		
FA 2750	LM amidated pectin, citrus, high calcium reactive	21		

Product Suitability

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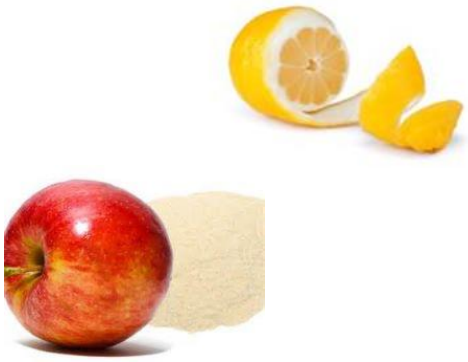
It is in the interest of the customer and user to determine whether our products are suitable for the intended use and if they do comply with all applicable laws and regulations valid for the food industry in their country and also observe all third-party rights



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