



**Fruit Preparations  
for Bakery Products**



2



# CONTENT

<b>FRUIT PREPARATIONS FOR BAKERY PRODUCTS</b>	<b>4</b>
<b>REQUIREMENTS ON FRUIT PREPARATIONS FOR BAKERY PRODUCTS</b>	<b>5</b>
Manufacturing of the fruit preparation	5
Baking process	6
After baking	7
<b>STANDARD TESTS TO DETERMINE THE QUALITY</b>	<b>8</b>
Baking stability	8
Tendency to syneresis	10
<b>GELLING BEHAVIOUR OF PECTINS</b>	<b>11</b>
Structure of pectin	11
Gelling mechanisms	11
Factors influencing the gelation of low methylester pectins	13
<b>SPECIFIC INFLUENCE ON TEXTURE AND BAKING STABILITY BY LOW METHYLESTER H&amp;F CLASSIC PECTIN</b>	<b>17</b>
Setting temperature, pre-gelation and filling temperature	17
Influence of filling temperature on texture	18
Influence of setting temperature on baking stability and surface gloss	19
Influence of calcium salts	22
Use of different fruits	24
<b>HIGH METHYLESTER PECTINS FOR BAKING STABLE FRUIT PREPARATIONS</b>	<b>25</b>
<b>FRUIT PREPARATIONS FOR BAKERY PRODUCTS WITH LOW SOLUBLE SOLIDS CONTENT</b>	<b>26</b>
<b>SELECTED RECIPES WITH H&amp;F PECTINS</b>	<b>27</b>
Traditional baking marmalade	27
Fruit preparations for bakery products	28
Fruit fillings	32
<b>SCHEMATIC PRODUCTION PROCESS</b>	<b>34</b>
<b>SPECIAL ADVANTAGES OF H&amp;F CLASSIC APPLE PECTINS</b>	<b>36</b>
<b>PRODUCT RANGE H&amp;F CLASSIC PECTINS</b>	<b>38</b>



Fig. 1: Bakery products, produced with fruit fillings, without having passed a baking process

## FRUIT PREPARATIONS *for bakery products*

Bakery products combined with a fruit preparation are very popular due to their fresh-fruity flavour.

In the production process of such bakery products the fruit preparations used are given onto the cold cakes after baking (e.g. fruit fillings for doughnuts) or they are baked together with the cake (e.g. Linzer tart).

The fruit preparations named **fruit fillings**, which are added to the cake after the baking process, are expected to show, besides the required flavour and texture, also very good properties regarding processing (e.g. pumping, dosing, injecting).

**Baking stable fruit preparations** are used for bakery products which pass the baking process together with the dough and which have to endure the heat emerging during the baking process without changing their shape and volume. In addition to the necessary baking stability they have to possess also excellent properties regarding processing and to show the desired texture in the finished product.

In order to reach the required sensory and technological properties in the production of different types of fruit preparations for bakery products the importance of using pectin increases. Especially with H&F Classic Pectins which are standardized to this application it is possible – in connection with the appropriate processing technology – to produce fruit fillings and baking stable fruit preparations which meet these requirements to a great extent.



# REQUIREMENTS

## *on fruit preparations for bakery products*

Fruit preparations for baked products are produced as bucket, drum or container goods. For processing the fruit preparations they are taken out of the respective packaging and given or injected to the dough or the finished cake.

The properties of the fruit preparations themselves are influenced decisively by processing technology, recipe parameters (calcium ion concentration, types of sugar, soluble solids content, pH-value, type of fruit) and the used pectin and/or the combination of these factors.

In order to guarantee an optimal course of production – starting with the manufacturing of the fruit preparation, the production process up to the storage of the finished bakery product – there are very high demands on baking stable fruit preparations which can be fulfilled with the suitable H&F Classic Pectins.

### ***Manufacturing of the fruit preparation***

In the industrial production of baking stable fruit preparations for the bakery industry, these are steadily stressed mechanically during the cooling phase and then filled into larger packagings (e.g. containers) in cold condition. With that the forming of an elastic gel network is prevented and a non gelled, creamy and pasty product with the requested firmness results.

After filling and storage in containers the fruit preparation is expected to be well processable again and not to change its texture after mechanical stressing (e.g. pumping, stirring, dosing). That means a pseudo-plastic texture is required which is able to regenerate very well.

Additionally no post-gelation or syneresis (release of water from the gel) may occur during storage. This product stability over the whole storage time in the packaging as well as during the best before period of the finished bakery products is of great importance.

***Low methylester H&F Classic Pectins offer very special advantages for the production of baked products***

Due to the careful pectin production, the specific molecular structure and the special standardization to this application, fruit preparations with optimal smoothness and, at the same time, high firmness can be produced meeting all requirements of the industry.

*Fig. 2: Bakery products, produced with baking stable fruit preparations having passed a baking process*



***Fruit preparations for baked products, produced with H&F Classic Pectins are characterized especially by***

- excellent pumpability,
- smooth texture and high firmness at the same time,
- high resistance towards mechanical stress,
- excellent regeneration ability, also after mechanical stressing,
- very low tendency to syneresis,
- high tolerance towards varying pH-values of the final product,
- possibility to adjust filling temperature to packaging size,
- surface gloss,
- excellent release of flavour and taste

Fruit fillings, which are given onto or injected in the finished bakery product after the baking process, show a high viscous and very smooth and creamy texture providing also the surface gloss of the fruit layer.

Caused by pumping and dosing, these fruit fillings are exposed to high mechanical stress. The challenge of the pectin is to form a stable texture free from syneresis, with excellent regeneration ability, that the fruit preparation maintains its form and freshness after the dosing and also during a longer storage.

***Baking process***

Baking stable fruit preparations which are given on or injected in the dough prior to the baking process, have to possess limited or full baking stability, depending on the demands.

Together with the dough the fruit preparation is exposed to a defined heat for a certain time during the baking process in the oven. If a fruit preparation is baking stable it will not change its original shape under this heat. That means it does not start boiling nor melting and does also not show syneresis.

Deficient, that means non baking stable fruit preparations melt under the given conditions and start to flow or, due to the oven temperature, they begin to boil and bubbles start forming because of steam formation. These bubbles finally escape at the surface resulting in an undesired and not controllable change of the product surface. This is also called "cratering".





When producing such particular products like Linzer tart a certain, intended melting of the fruit preparation during the baking process may be desired.

If the fruit preparation only melts at the surface under the given temperature, this will result in a nice surface gloss giving the cake an attractive surface without changing the original shape significantly.

This is called a limited baking stability.

#### **After baking**

As baking stable fruit preparations are mainly used for bakery products with a long shelf life it is specially important that the cakes keep their optimal quality over a longer period of time. Therefore the fruit preparation is expected to be stable also after baking and it may not release water, i.e. it may not show any tendency to syneresis.

Ideally the aw-value of the fruit preparation complies additionally with that of the bakery product.

With H&F Classic Pectins fully baking stable and also limited baking stable fruit preparations with controlled melting of the surface can be produced.

*Fig. 3: Baking stable and non baking stable fruit preparation*



#### **H&F Classic Pectins guarantee:**

- Stability of texture also during longer storage time
- Specific standardization of the desired baking stability
- No tendency to syneresis
- Highest functionality also for fruit preparations with an aw-value in the range of the bakery products

# STANDARD TESTS to determine the quality

## **Determination of baking stability**

The baking stability of a fruit preparation can be determined by means of standard tests in a laboratory.

With these tests a defined amount of fruit preparation is given onto a base by a metal ring with defined geometry and is baked under exactly defined conditions.

During and after the baking the changes in shape and volume are observed and evaluated.

The test conditions are chosen as close to practice as possible – this resulted in the development of three standard tests in dependence from the different demands on fruit preparations. These tests proved themselves in quality control.

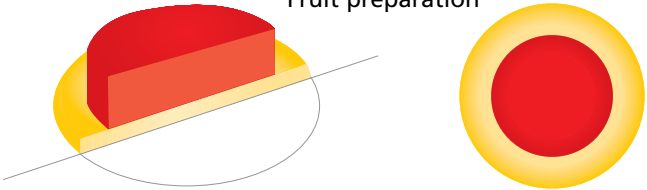
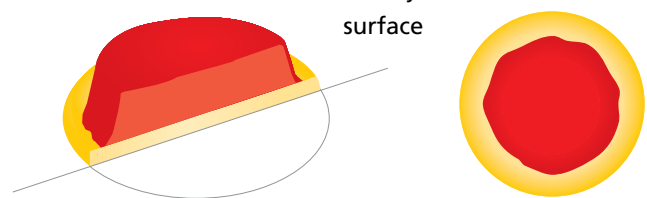
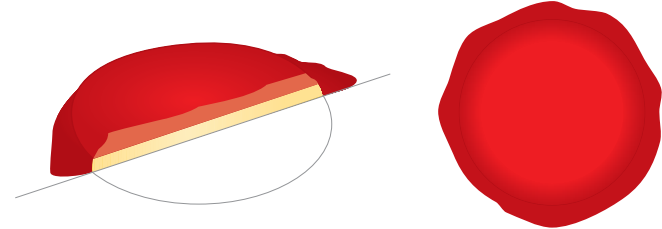
<p><b>Baking stable</b></p>	<p>Fruit preparation</p> 
<p><b>Limited baking stable</b></p>	<p>Glossy surface</p> 
<p><b>Non baking stable</b></p>	

Fig. 4: Evaluation of baking stability



### **Baking test 1 (BT1)**

Baking test 1 (BT1) is used to evaluate fruit preparations which are limited baking stable. The fruit preparation is given onto a short dough patty by means of a standardized metal ring and is baked.

Metal ring:	40mm, height 5mm
Short dough patty:	50mm, height 4mm
Baking time:	15minutes
Oven temperature:	200°C
(pre-heated, top and bottom heat)	

### **Baking test 2 (BT2)**

Baking test 2 (BT 2) is a more severe test which is used for evaluation of fruit preparations with high baking stability.

The fruit preparation is given onto a short dough patty also by means of a standardized metal ring. However, in comparison to BT 1 the baking time is longer.

Metal ring:	60mm, height 10mm
Short dough patty:	80mm, height 4mm
Baking time:	20minutes
Oven temperature:	200°C
(pre-heated, top and bottom heat)	

### **Baking test 3 (BT3)**

This baking test is even more severe and is used for evaluation of fruit preparations with a very high baking stability. Instead of the short dough filter paper is used as base. Thus the fruit preparation is almost directly in contact with the baking tray and is exposed more strongly to the heat from the bottom than in BT 1 and BT 2.

Metal ring:	60mm, height 10mm
Filter paper:	90mm
Baking time:	20minutes
Oven temperature:	200°C
(pre-heated, top and bottom heat)	

Figure 4 shows the evaluation scheme for the above mentioned three baking tests.

A fruit preparation is called baking stable if during baking it does neither melt nor boil and no bubble formation or only little changes in shape and volume occur.

Limited baking stability means that the fruit preparation shows a slight melting at the surface without any changes of the original shape resulting in a nice gloss.

If the fruit preparation has melted completely it is not baking stable.



Fig. 5: Baking test 3 (left to right limited baking stable, baking stable, not baking stable)



Fig. 6: Syneresis test

#### **Evaluation of tendency to syneresis**

Syneresis is the discharge of liquid out of a gel and an undesirable emergence for fruit preparations for bakery products.

Syneresis mainly occurs after mechanical destruction of the gel network. The stronger the tendency to syneresis, the more liquid can discharge from the gel. Fruit preparations with syneresis show a diminished baking stability and, due to the liquid loss, result in discolouring and soaking of the cake. Furthermore, the fruit preparation loses freshness and quality caused by the liquid loss.

Before and after the baking process, fruit preparations for bakery products are tested concerning their tendency to syneresis to fulfill the specific demands as regards production, baking process and storage.

The fruit preparation is given onto a filter paper by means of a standardized metal ring. The filter paper absorbs the water which is not

bound ("syneresis") with which a "corona" around the fruit preparation becomes visible.

The determination of the tendency to syneresis prior to the baking process is done after a defined period after placing the fruit preparation on the filter with measuring the diameter of this "corona". The larger the diameter of this "corona" is, the larger is the tendency to syneresis.

Afterwards this fruit preparation is baked under exactly defined conditions.

The determination of the tendency to syneresis after baking is done immediately after the cooling of the bakery product. For this purpose, the diameter of the "corona" is measured again and additionally the surface of the fruit preparation is assessed optically. Many small "craters" caused by elusion of steam, point at an insufficient binding of water and with that to a high tendency to syneresis.



## GELLING BEHAVIOUR of pectins

### Structure of pectin

Pectin is an important structure element of all plant food. Chemically seen pectin is a macromolecular substance which belongs to the heteropolysaccharides. The main part is polygalacturonic acid which is partially esterified with methanol.

If the degree of esterification is more than 50% the pectin is a high methylester pectin, if the degree of esterification is less than 50% the pectin is a low methylester pectin.

### Gelling mechanisms

According to modern theories of gel formation the regular zones of the pectin macromolecules bond together to bonding zones during the gelation process. These bonding zones are interrupted by the presence of neutral sugar side chains and so new bonding zones form at another place. With that the formation of a three-dimensional network is possible which is able to immobilize large quantities of water.

### Gel formation of high methylester pectins

For high methylester pectins, on the one side hydrophobic interactions emerge between the methylester groups at the adhesive zones which are necessary for gelation. On the other side, there are hydrogen bonds which may develop for example between free, not dissociated carboxyl groups of the pectin chains.

At this so called sugar acid gelling mechanism a high concentration of sugar degrades the water activity of the system. The pectin chains are dehydrated and can more easily converge. The addition of acid causes the repulsion of the dissociation of free carboxyl groups and with that the mutual repulsion of negatively charged pectin molecules is repressed.

Optimal conditions for the gelation of high methylester pectins are a soluble solids content of more than 60% and a pH-value in the range of pH 3.0.

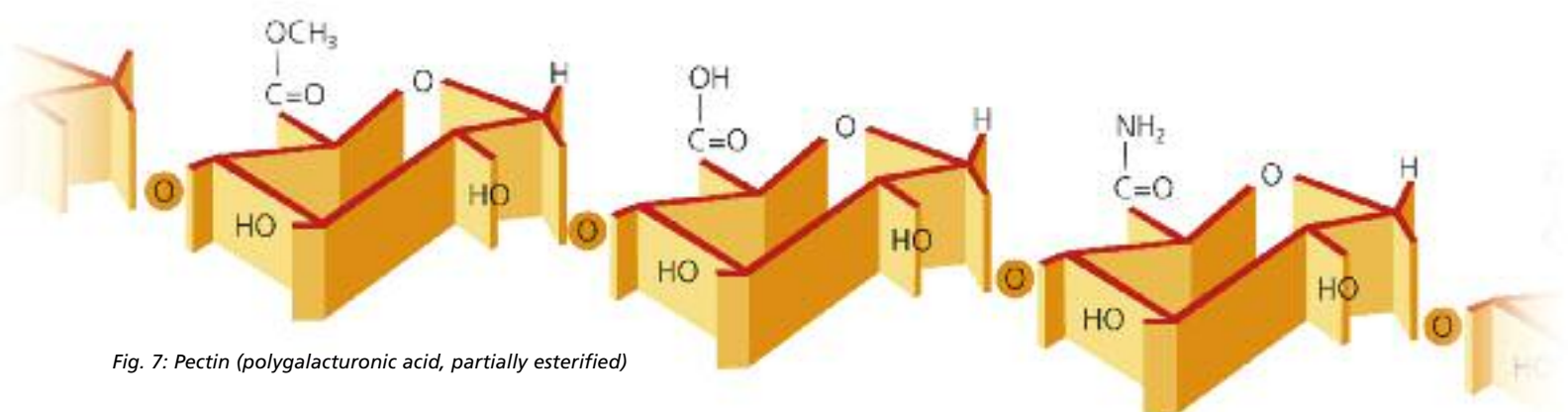
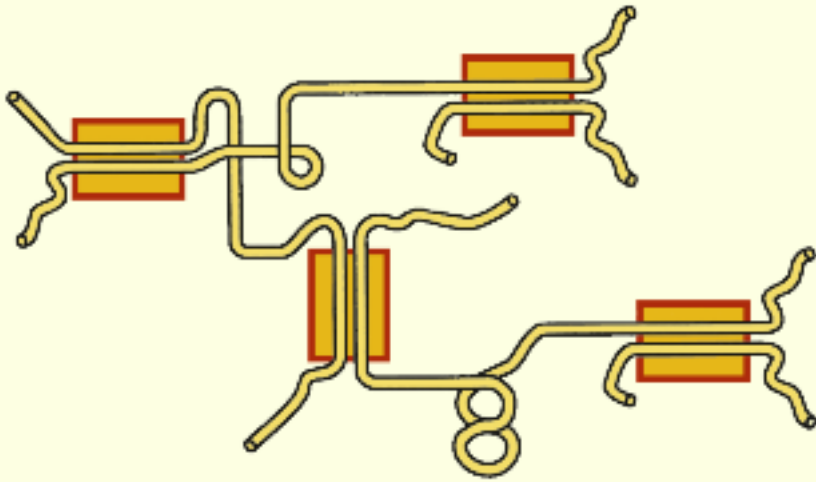


Fig. 7: Pectin (polygalacturonic acid, partially esterified)



**Gel formation of low methylester pectins**

Low methylester pectins also gel according to the "sugar acid gelling mechanism" as high methylester pectins do. Additionally low methylester pectins are able to form bonding zones with bivalent cations e.g. calcium ions. The binding is effected by complexation of the bivalent ions ("egg-box" gelling model). The gelation with calcium ions is relatively independent from soluble solids content and pH-value of the product.

Fig. 8: Formation of adhesive zones during gelation

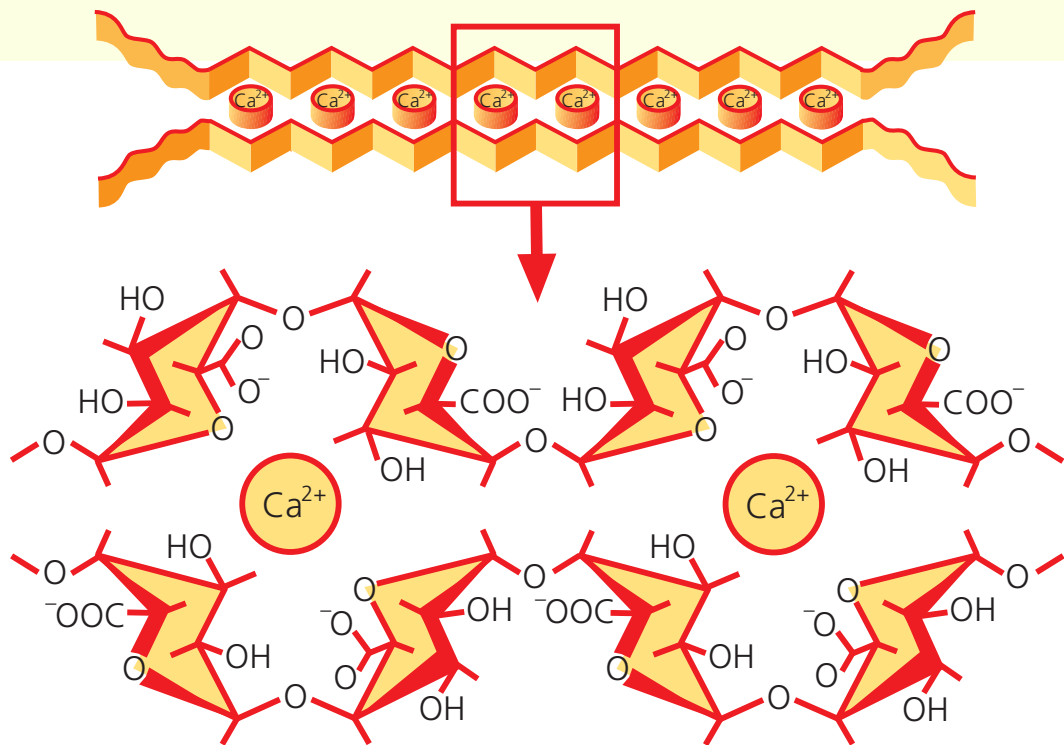


Fig. 9: "egg box" gelling model



**Factors influencing the gelation of low methylester pectins**

**Influence of calcium ion concentration**

The calcium ion concentration which is necessary for an optimal gelation thereby depends on different product parameters such as soluble solids content, type of sugar (mono- or disaccharide, sugar alcohols, glycerine, etc.), pH-value and buffer system.

If the addition of calcium to the pectin system is low the pectin chains will start to stick together through calcium bonds resulting in an increasing viscosity (see fig. 10).

With an increase of the calcium dosage a gel is formed which will become firmer and more elastic with increasing calcium dosage.

If the calcium dosage exceeds a defined maximum a so called pre-gelation will occur under the given conditions.

If the calcium concentration is increased even more, then calcium pectinate will precipitate under the given production conditions.

To obtain baking stable fruit preparations without syneresis, the calcium ion concentration has to be selected that way that a controlled pre-gelation is initiated when cooling down to the filling temperature. In doing so, fine gel particles will form and the fruit preparation reaches the desired pseudoplastic character.

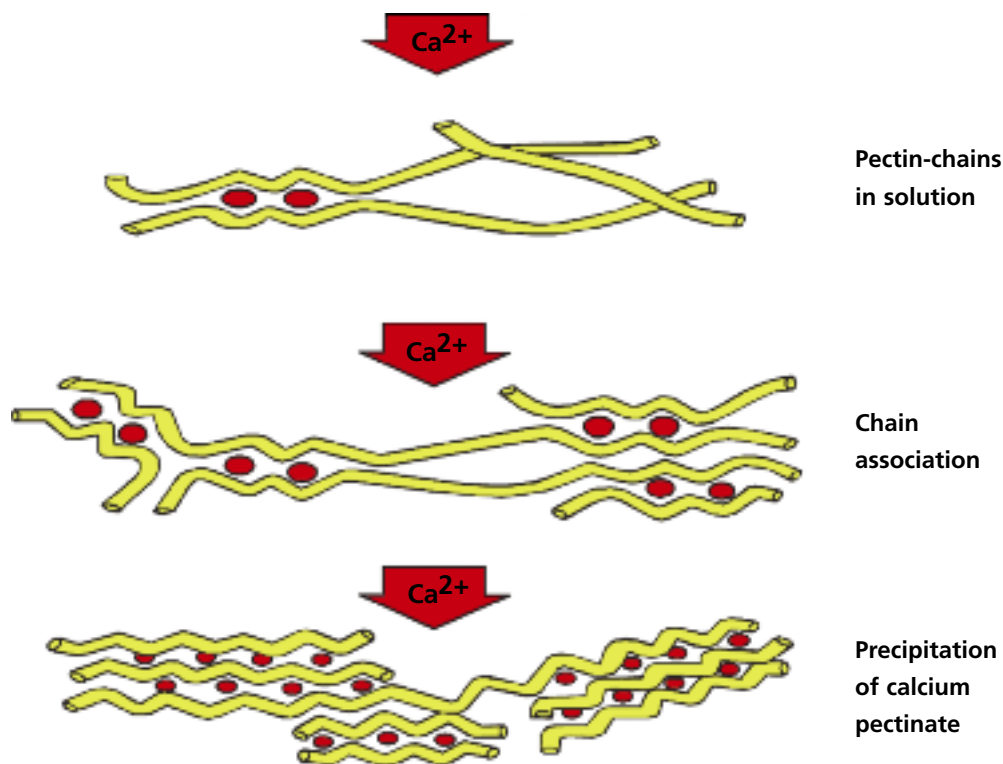


Fig. 10: Influence of calcium concentration on the formation of adhesive zones



#### ***Influence of the product pH-value***

For low methylester pectins, the breaking strength and the maximum reachable gel strength decrease if the pH-value of the final product is raised, the gels become weaker and the texture more viscous.

With raising the pH-value also the calcium need, which is necessary to reach a defined gel strength, increases. Furthermore the working range becomes wider. This means that gels with higher pH-values (e.g. pH 4.0) are more tolerant towards fluctuations of the calcium content compared with gels with lower pH-values (e.g. pH 3.0). With that, in the production of fruit preparations for bakery products the tolerance range and product safety are adequately increased.

Raising the pH-value results in an increase of charged molecules in the gel. Now the calcium ions react stronger with other negatively charged buffer substances. With that the share of calcium ions reacting with the pectin decreases.

Due to the pH-value conditioned stronger dissociation of free carboxyl groups the pectin chains repel mutually more strongly whereby the gelling strength decreases.

Raising the calcium ion concentration creates again more cross linkages between pectin molecules and thus increasing gelling strength.



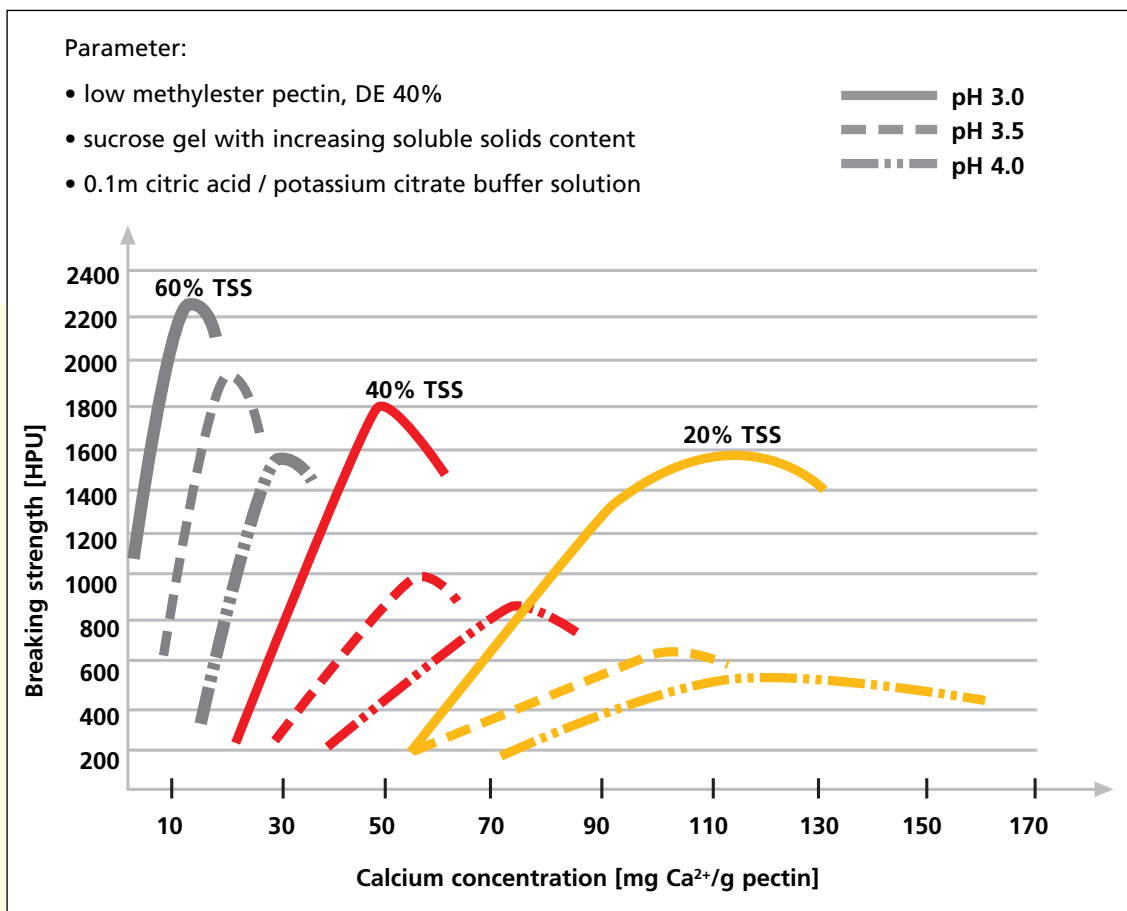


Fig. 11: Breaking strength of low methylester pectins in dependence from calcium content under the influence of soluble solids content and pH-value of the product

### Influence of soluble solids content

An important parameter for the selection of suitable pectins for fruit preparation for bakery products is the soluble solids content of the formulation, which significantly influences the gelling properties of low methylester pectins.

For gels, which are produced with low methylester pectins, the maximum reachable breaking strength is highest, when the soluble solids

content is highest. For reaching this maximum breaking strength resp. for forming a comparably firm gel, a lower dosage of calcium ions is required at high soluble solids contents (e.g. 60% TSS) than at less high soluble solids contents (e.g. 20% TSS).

At the same time the "working range", at which the gels are firm but not pre-gelled, becomes wider with decreasing soluble solids content.

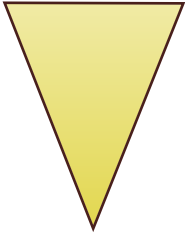
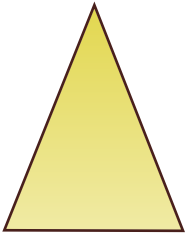
	Sweetening power	Viscosity of fruit preparations (constant Ca <sup>2+</sup> dosage)	Calcium need for optimal gelation
sucrose	100		
glucose	50		
fructose	110		
sorbitol	70		

Fig. 12: Influence of sugar type

#### ***Influence of sugar type***

Besides the sugar concentration also the type of sugar has an important influence on gelling properties and baking stability.

Thus the required amount of calcium for the best possible gelation is much higher in gels with sorbitol than in gels with sucrose. Gels with fructose and glucose are somewhere in between. A further influence of the used type of sugar on gelling properties and with that on baking stability can also be observed.

The type of sugar used additionally influences viscosity, sweetness impression and taste profile of the baking stable fruit preparations.

#### ***Influence of buffer salts***

Buffer salts and buffer systems, like sodium citrate or potassium citrate in combination with citric acid, are used in the production process of gels in order to minimize variations regarding pH-value of the final product and to create a defined taste profile.

Buffer ions of the fruit get into the fruit preparation naturally when using fruit or fruit pulps for production. Type and concentration of present buffer ions have a significant influence on the required amount of calcium ions in order to reach a specified gel strength and baking stability.

If the concentration of buffer salts at a constant pH-value is raised in a recipe, then the calcium dosage also has to be raised in order to get comparable gel strength and baking stability.

On the one hand this is necessary because some buffer substances may form stable complexes with the calcium ions and thus withdrawing calcium from the pectin.

On the other hand, negatively charged buffer ions disturb the formation of a homogeneous gel structure. An increased dosage of calcium ions creates more bondings between the pectin chains and consequently supports the gel formation.



**SPECIFIC INFLUENCE**  
*on texture and baking stability by  
 low methylester H&F Classic Pectin*

**Setting temperature, pre-gelation and filling temperature**

By means of setting temperature, controlled pre-gelation and selected filling temperature it is possible to control texture and baking stability of the fruit preparation specifically.

When reaching the setting temperature, the sol-gel transition, that means the transition from liquid to gelled phase takes place.

The setting temperature of a pectin solution is decisively influenced by the concentration of calcium ions and increases progressively with increasing calcium dosage.

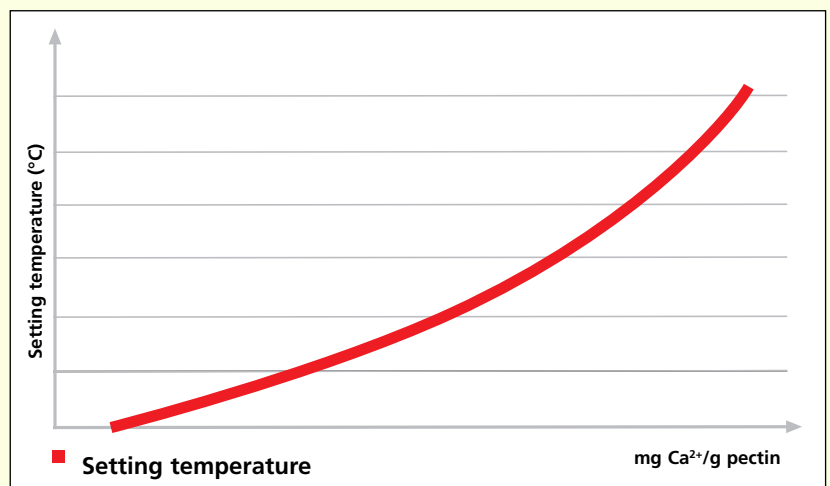


Fig. 13: Setting temperature of gels with low methylester H&F Classic Pectin

**Influence of filling temperature on texture**

The setting temperature determines the range in which the filling temperature has to be in order to prevent pre-gelation or to effect it specifically.

Pre-gelation, which is necessary for baking stability, develops whenever the filling temperature is below the setting temperature. Then the pectin forms a gel network already in the production process during the cooling phase and with that before the filling process.

At the same time this gel network is stressed mechanically during cooling or in the following filling process. Resulting from this and depending from the selected filling temperature the gel strength will be reduced. In return, the desired pseudoplastic and creamy texture with the necessary baking stability develops.

With the selection of various H&F Classic Pectins, furthermore, the desired texture can be additionally influenced and specifically effected.

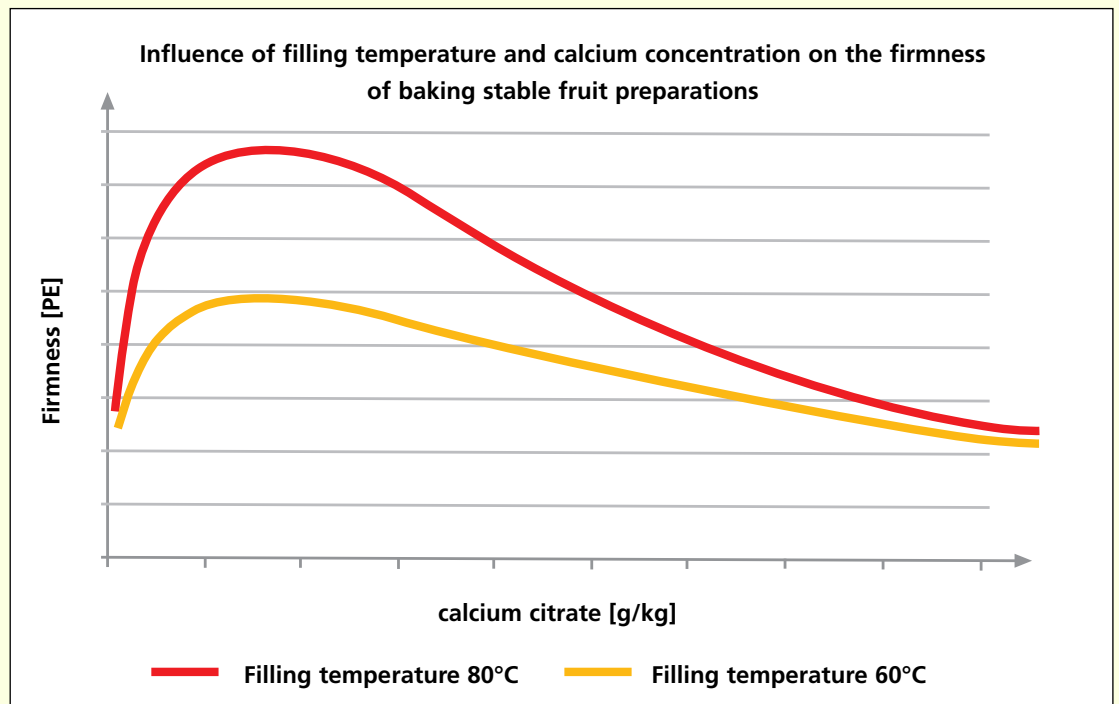


Fig. 14: Setting temperature and gelling strength in dependence from calcium concentration



### ***Influence of setting temperature on baking stability and surface gloss***

#### ***Baking stability***

A fruit preparation is called baking stable if it does neither start boiling nor melting under the given conditions during the baking process (temperature, baking time) and if it retains its original form and shape.

The melting of the fruit preparation is influenced by the time and the oven temperature of the baking process. A gel starts melting if it is exposed for a short time to a temperature much higher than the melting temperature or if it is exposed for a longer time to temperatures in the range of the melting temperature.

The melting temperature of pectin gels is slightly higher than the setting temperature. These two temperatures are closely connected. The higher the setting temperature is, the higher the corresponding melting temperature is.

Thus, also the melting temperature of the fruit preparation can be controlled by the calcium dosage which already influences the setting temperature directly.

This means for baking stable fruit preparations produced with low methylester H&F Classic pectins, that with an increase in calcium concentration also the melting temperature increases resulting in an improved baking stability.

At a defined calcium dosage the baking stability reaches its maximum. If the calcium dosage is still increased also the setting temperature will increase but the baking stability will gradually decrease.

The reason for this is the reaction between the low methylester pectin and the added calcium ions.

As of a defined calcium dosage so many bonds between the pectin chains form that a deposit of water into the gel structure is prevented.

During the baking process this free water would lead to boiling of the fruit preparation which would result in bubble formation and in a change of the original shape.

At which level the melting temperature finally has to be depends on the desired product and on the production process of the bakery product.

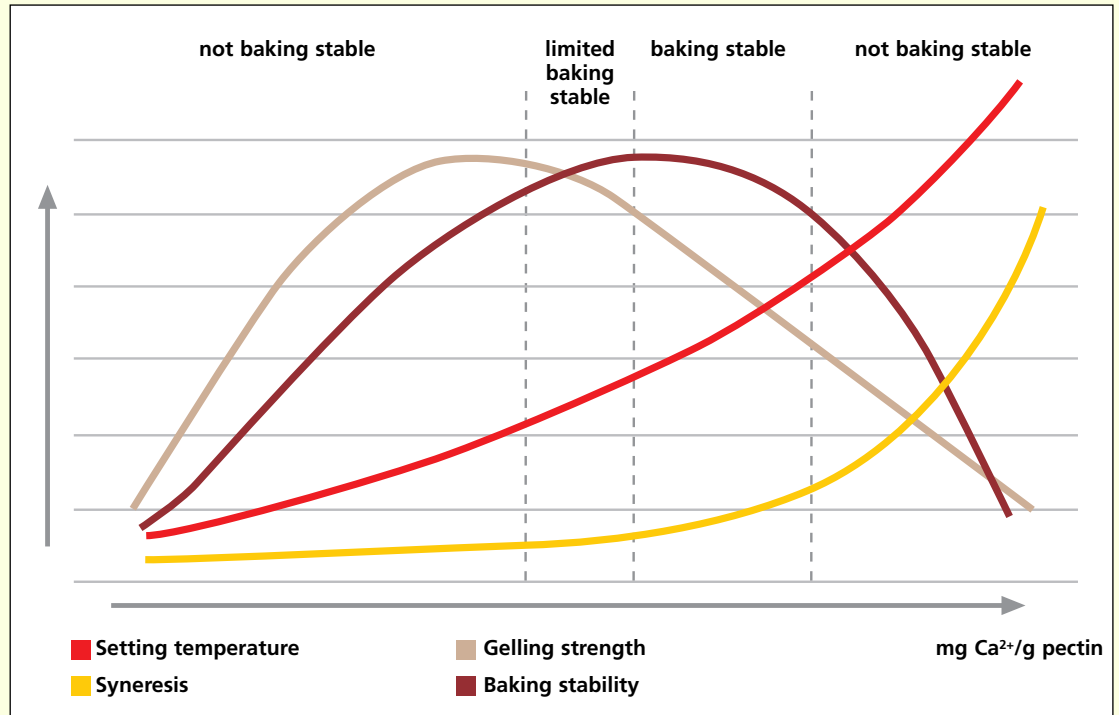


Fig. 15: Scheme of setting temperature, gelling strength, baking stability and syneresis volume in dependence from calcium ion concentration

### Surface gloss

If very high baking stable products with a more dull surface are desired the melting temperature of the fruit preparation has to be higher than the temperature in the oven. Under these conditions the fruit preparation will not change its original shape during the baking process.

Products with a brilliantly shiny, glossy surface can be produced if fruit preparations with a melting temperature only slightly lower than the oven temperature are used. Under these conditions the fruit preparation only melts at the surface during the baking process. Due to the heat transfer the inside temperature of the fruit preparation does not exceed the melting temperature of the fruit preparation and the original shape does not change.



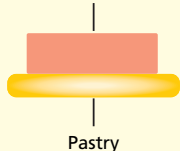
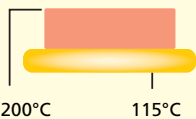
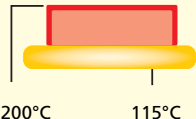

Oven 200°C	<p>Fruit preparation</p>  <p>Pastry</p>	Before baking
Melting temperature > 200°C	<p>Dull surface</p>  <p>200°C 115°C</p>	"Baking stable"
Melting temperature 115-200°C	<p>shiny surface</p>  <p>200°C 115°C</p>	"Limited baking stable"
Melting temperature < 115°C		"Not baking stable"

Fig. 16: Surface effects and form changes

As the top layer of the fruit preparation is heated to a temperature above the melting temperature, the pectin molecules can rearrange themselves again during the following cooling phase. An elastic and transparent gel layer develops giving the product the desired brilliant gloss.

Pectin Classic AB 902 is very well suited for this application as due to the specific manufacturing process of this low methylester pectin the melting temperature can be adjusted specifically well.

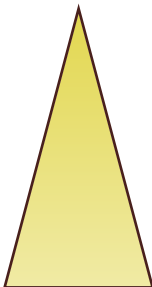
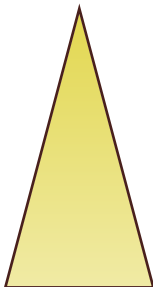
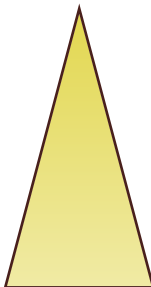
	Formula	Calcium content	Velocity of dissociation	Solubility	Structure of pre-gelled fruit preparations
<i>tri</i> -calcium-orthophosphate	Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>	38.76%	slow	bad	fine
<i>tri</i> -calcium-dicitrate	C <sub>12</sub> H <sub>10</sub> Ca <sub>3</sub> O <sub>14</sub> x 4H <sub>2</sub> O	21.08%			
calcium lactate	C <sub>6</sub> H <sub>10</sub> CaO <sub>6</sub> x 5H <sub>2</sub> O	13.00%			
calcium chloride	CaCl <sub>2</sub> x 2H <sub>2</sub> O	27.26%			

Fig. 17: Different calcium salts and their properties

***Influence of calcium salts***

In contrast to jams and marmalades a pre-gelled texture is desired in the production process of baking stable fruit preparations with low methylester pectin.

This desired pre-gelation is reached by specifically dosing a selection of calcium salts under consideration of the other production parameters.

Due to this controlled pre-gelation baking stable fruit preparations with a typically pasty texture, low tendency to syneresis and very excellent processing properties can be obtained.

The flow behaviour of these products is plastic and/or pseudo-plastic with a yield point. A yield point causes a defined firmness in quiescent conditions resulting in an unchanged shape of the fruit preparation on the dough.



However, if there is mechanical stress on the product which is larger than the yield point, the fruit preparation will start to flow pseudo-plastically. Pseudo-plasticity means that the viscosity decreases with increasing stress.

Mechanical stress occurs during the processing, e.g. during pumping or dispensing. The more the viscosity decreases during stress, the better the pumpability will be.

After the stressing the fruit preparation regains its original viscosity. Also yield point and with that the original firmness are regained after a defined time of regeneration.

#### ***Selection of calcium salt***

For the production of baking stable fruit preparations different calcium salts can be applied in practice. Each of these salts shows other properties concerning solubility, dissociation behaviour and the ability to build complexes.

These properties mainly depend on concentration, pH-value of the medium and temperature.

The selection of the appropriate calcium salt for the production of baking stable fruit

preparations should be made considering the following aspects:

- pH-value of the product

Usually calcium citrate is used as a calcium source in the food industry. However, calcium citrate is difficult to dissolve in products with higher pH-values. In this case calcium lactate is the more appropriate calcium salt due to its better solubility.

- Texture

The texture of a baking stable fruit preparation depends on the velocity of the pre-gelation. This velocity can be ruled by the dissociation behaviour of the calcium salt used.

A salt, which is immediately disposing the calcium ions due to its high dissociation behaviour (e.g. calcium chloride) results in a quick pre-gelation and with that in a coarse texture. With the addition of calcium salts with a lower dissociation (e.g. calcium citrate) the pre-gelation is slower resulting in fine and creamy textures (see fig. 17).

Fruit type	Soluble solids content	Total dietary fibre content, soluble / insoluble	Pectin content	Total acid content	fruit owned Ca <sup>2+</sup> content
Apple	15-16%	total: 20.3g/kg soluble: 4.8g/kg insoluble: 15.5g/kg	0.61%	4.6g/kg	abt. 60mg/kg
Apricot	13-15%	total: 15.4g/kg soluble: 7.1g/kg insoluble: 8.3g/kg	0.99%	14.0g/kg	abt. 160mg/kg
Raspberry	14-15%	total: 46.8g/kg soluble: 9.8g/kg insoluble: 37.0g/kg	0.40%	21.2g/kg	abt. 400mg/kg
Cherry	15-16%	gesamt: 10.4g/kg soluble: 5.7g/kg insoluble: 4.7g/kg	0.30%	18.0g/kg	abt. 80mg/kg

Fig. 18: Frequently used fruits for the application in fruit preparations for bakery products

Source: Souci-Fachmann-Kraut "Die Zusammensetzung der Lebensmittel, Nährwert-Tabellen", 2000  
\*K. Herrmann, "Obst, Obstdauerwaren u. Obsterzeugnisse", 1996

#### **Application of different fruits**

Due to their components the different fruit and / or fruit pulps which are used for the production of fruit preparations for bakery products influence texture and baking stability in different ways.

Depending on the used fruit especially the soluble solids content, the content of fibres and / or dietary fibres, the pH-value of the fruit, the content of total acid and with that the pH-value and calcium content can influence the final product.

In order to manufacture products with constant properties it may be necessary to consider these differences of the fruit used in the recipe. For example fruits with a naturally low calcium content (e.g. apples) have a higher calcium need than naturally calcium rich fruits (e.g. raspberries).

Fig. 18 shows the components of the four most frequently used fruits which are important for the production of fruit preparations.





## HIGH METHYLESTER PECTINS *for baking stable fruit preparations*

Fruit preparations for the industrial production of bakery products are almost exclusively produced with low methylester pectins. In contrast, high methylester pectins are commonly used in fruit preparations for the traditional manufacturing of bakery products.

The advantage of high methylester pectins is their high setting temperature and with that also the high melting temperature of the gels. Fruit preparations which are produced with high methylester pectins therefore show an excellent baking stability.

The gel network formed by high methylester pectins, however, can be destroyed easily under mechanical stress. With destroying this gel structure the bound water is released again. Syneresis emerges and the fruit preparation loses its baking stability because the released water will start to boil during the baking process.

Thus, fruit preparations produced with high methylester pectins may be exposed only to possibly low mechanical stress during the processing (pumping, dosing etc.) which is mostly only possible in the traditional manufacturing of bakery products. In the industrial production, however, too much mechanical stress influences the gel network which is the reason why low methylester pectins are used for this application.

In practice, high methylester apple pectins are frequently used today. The advantage of the apple pectins is that they are able to form a viscous, creamy gel network with a very high water binding capacity. Compared to citrus pectins, this improves the resistance of the gel towards the mechanical treatment and reduces the tendency to syneresis.

# FRUIT PREPARATIONS

## *for baked products with low soluble solids content*

Fruit preparations with a low soluble solids content of e.g. 30-40°Bx are more and more used in fresh bakery products with a short shelf life. Caused by the low sugar content there is much more free water present in the fruit preparation, which increases the demands on the low methylester pectin.

Due to the high water binding capacity of apple pectins it is possible to produce fruit preparations with low soluble solids content showing an excellent baking stability and only low tendency to syneresis. Additionally, with using a combination of low methylester apple pectins and Herbacel AQ Plus Citrus Fibre\*) the baking stability can be increased.

Furthermore, the fruit preparation shows an extremely creamy texture, a pleasant mouth-feeling and very low tendency to syneresis. With the use of Herbacel AQ Plus the product can additionally be called "high-fibre" if the dosage of Herbacel AQ Plus Citrus Fibre exceeds a defined amount (approx. 2.5%).

\*) Herbacel AQ Plus Citrus Fibre is a product of Herbafood Ingredients GmbH, [www.herbafood.com](http://www.herbafood.com).

*Recipe for a traditional baking stable fruit preparation with Pectin Classic AB 401*

### Herbstreith & Fox KG

#### *Baking stable fruit preparation*

Product **Pectin Classic AB 401**

120g Pectin solution 5% (=0.6%)  
350g Fruit pulp  
440g Sucrose  
200g Glucose syrup  
(15% dextrose, 15% maltose,  
13% maltotriose)  
x ml Citric acid solution 50% for  
adjusting the pH-value

Input: approx. 1110g  
Output: approx. 1000g  
TSS: approx. 65%  
pH-value: approx. 3.1



## SELECTED RECIPES with H&F Pectins

### **Traditional baking marmalade with high methylester H&F Classic Pectins**

The traditional baking jam is mostly filled into small buckets and then taken out in portions at the bakery shops. Due to this careful processing the gelled texture is hardly impaired here and high methylester pectins can be used. For these products high or medium methylester apple pectins are used, e.g. the H&F Apple Pectin Classic AB 401.

The following principles of pectin application have to be considered in the production of baking stable fruit preparations with Pectin Classic AB 401:

- The pectin is dissolved under ideal conditions, i.e. the soluble solids content is less than 30°Bx.
- The pH-value during the boiling process is relatively high (pH 4.0-4.5), so that the pectin is well soluble and the pectin degradation due to the heat treatment is as low as possible.
- With the addition of acid at the end of the boiling process the pH-value is reduced which effects the gelation process. Furthermore, the lower pH-value intensifies the fruit flavour.
- The filling temperature is higher than the setting temperature, that means the fruit preparation is filled in hot condition.

This traditional baking stable fruit preparation shows an extremely low tendency to syneresis and is characterized by an excellent spreadability.

## Recipe

### **Procedure:**

- Production of pectin solution (mix pectin dry with a part of sucrose, stir into water and heat to approx. 90°C).**
- Mix fruit, sucrose and glucose syrup and heat to approx. 90°C.**
- Stir in hot pectin solution and boil to final soluble solids content.**
- Add citric acid solution for adjusting the pH-value.**
- Cool down to necessary filling temperature of approx. 80°C) while stirring.**

***Fruit preparations for bakery products with low methylester H&F Classic Pectins***

Low methylester H&F Classic Pectins are mainly used for large-scale production of baking stable fruit preparations. With these low methylester pectins combined with an appropriate calcium salt it is possible to initiate a controlled process of pre-gelation and with that to obtain a baking stable product with a stable, easy to handle texture.

It is possible to add the calcium salt either separately or directly to the product formulation with the pectin already standardized with calcium salt.

During the production process the necessary amount of calcium salt (when added separately) is exactly adjusted to the desired properties

of the final product. The low methylester pectin used does not contain any buffer substances and is standardized to constant calcium sensitivity and gelling strength.

With that it is possible to produce fruit preparations over a wide range of soluble solids from extremely high baking stable to limited baking stable.

Depending on the desired texture of the fruit preparation the Apple Pectin Classic AB 901 (creamy, pasty texture with high viscosity) or the Apple Pectin Classic AB 908 (fine, creamy, dry texture with normal viscosity) can be used.

The following parameters have to be considered in the production technology of baking stable fruit preparations with low methylester H&F Classic Pectins:



- The pectin is dissolved under ideal conditions, i.e. the soluble solids content is less than 30°Bx and low calcium content.
- The pH-value during the boiling process is relatively high (pH 4.0-4.5). With that the pectin is well soluble and the pectin degradation due to the heat treatment is as low as possible.
- The addition of the calcium salt is preferably carried out at a temperature of 80°C as suspension in a sugar solution (slurry). Under these conditions a homogeneous distribution of the calcium ions in the product is guaranteed when using a calcium salt of bad solubility.
- If the calcium salt has to be added to the formulation at an earlier time due to technical reasons, slowly dissolving salts should be preferred in order to not affect the dissolving of the pectin.
- The addition of acid for intensification of the fruit flavour takes place at the end of the boiling process. With this adjustment of the pH-value a controlled pre-gelation is initiated. During the cooling process the viscosity of the fruit preparations increases steadily.
- The filling of the fruit preparation is effected at temperatures of approx. 40°C depending on the packaging size.



Pectin Classic AB 802, Pectin Classic AB 902 and Pectin Classic AB 903 are already standardized with calcium salts and are used for the production of fruit preparations with a creamy texture.

After the baking process these products show a brilliant, shiny surface resulting from the desired limited baking stability, that means the

intended melting at the surface during baking the baking process.

The use of pectins already standardized with calcium salts facilitates the production of fruit preparations and guarantees a stable production.

Herbstreith & Fox KG

## Recipe

### *Baking stable fruit preparation*

Product **Pectin Classic AB 902**

200g Pectin solution 5% (=1.0%)  
 250g Fruit pulp  
 520g Sucrose  
 200g Glucose syrup  
 (15% dextrose, 15% maltose,  
 13% maltotriose)  
 x ml Citric acid solution 50% for  
 adjusting the pH-value

Input: approx. 1170g  
 Output: approx. 1000g  
 TSS: approx. 72%  
 pH-value: approx. 3.5

#### Procedure:

- A Production of pectin solution (mix pectin dry with a part of sucrose, stir into water and heat to approx. 90°C).
- B Mix fruit pulp, glucose syrup and sucrose and heat to abt. 90°C.
- C Stir in the hot pectin solution and boil to final soluble solids content.
- D Add citric acid solution for adjusting the pH-value.
- E Cool down while stirring to necessary filling temperature (50-60°C).

*Recipe for baking stable fruit preparations with Pectin Classic AB 902*



***Baking stable fruit preparation***
**Product Pectin Classic AB 802**

12g	Pectin (= 1.2%)
350g	Fruit pulp
490g	Sucrose
150g	Glucose syrup (15% dextrose, 15% maltose, 13% maltotriose)
x ml	Citric acid solution 50% for adjusting the pH-value

<b>Input:</b>	<b>approx. 1050g</b>
<b>Output:</b>	<b>approx. 1000g</b>
<b>TSS:</b>	<b>approx. 65%</b>
<b>pH-value:</b>	<b>approx. 3.3-3.5</b>

**Procedure:**

- A** Mix the pectin with abt. 10g sucrose (from total sucrose amount).
- B** Stir in mixture A into fruit pulp and boil while stirring until the pectin has dissolved completely.
- C** Add the remaining sucrose and glucose syrup and boil to final soluble solids content.
- D** Add citric acid solution for adjusting the pH-value.
- E** Cool down while stirring to filling temperature of abt. 50-60°C.

*Recipe for baking stable fruit preparations with Pectin Classic AB 802*

Baking stable fruit preparations produced with Pectin Classic AB 902 possess a pasty, pumpable texture. The texture of fruit preparations which are produced with Pectin Classic AB 803 are smooth and creamy. With both pectins medium high baking stabilities can be reached which will slightly melt during the baking process and with that result in a glossy and shiny surface. When using these pectins the separate addition of calcium is not necessary. These pectins can be flexibly used at different soluble solids contents. The product firmness as well as the desired baking stability can be controlled by the pectin dosage.

If a baking stable fruit preparation is filled at high temperatures (e.g. at abt. 80°C), the

product will show a pre-gelled texture with high firmness and gel character after cooling. With that the following handling of the product may become difficult. If this fruit preparation is again stressed mechanically during or after the cooling process (e.g. by stirring or pumping), the gel character will change to the desired pseudo-plastic and pasty texture.

If after the boiling process the baking stable fruit preparations are cooled under mechanical stress (e.g. by stirring) and filled afterwards, the products show a pasty, non gelled texture which is more creamy and easier to process in comparison to the products filled in hot condition.

**Baking stable fruit preparation**Product **Pectin Classic AB 901 resp. Classic AB 908**

12g	Pectin (= 1.2%)
300g	Apple pulp
490g	Sucrose
150g	Glucose syrup (15% dextrose, 15% maltose, 13% maltotriose)
50g	Water
1.5g	tri-sodium citrate x 2H <sub>2</sub> O
1.0g	tri-calcium dicitrate x 4H <sub>2</sub> O
x ml	Citric acid solution 50% for adjusting the pH-value

Input:	approx. 1000g
Output:	approx. 1000g
TSS:	approx. 65%
pH-value:	3.5-3.6

**Procedure:**

- A Mix pectin with approx. 100g sucrose.
- B Stir mixture A into the fruit pulp and the remaining water while stirring.
- C Boil while stirring until the pectin has dissolved completely.
- D Add the remaining sucrose and glucose syrup and boil to final soluble solids content.
- E Stir in sucrose (abt. 60g), calcium citrate and sodium citrate in abt. 40g hot water (min. 80°C).
- F Stir in mixture E.
- G Add citric acid solution for adjusting the pH-value.
- H Cool down to necessary filling temperature (40-60°C) while stirring.

*Recipe for baking stable fruit preparations with Pectin Classic AB 901 / Pectin Classic AB 908*

Baking stable fruit preparations produced with Pectin Classic AB 901 possess a pasty, smooth texture. In contrast, the texture of fruit preparations which are produced with Pectin Classic AB 908 are very fine and creamy. With both pectins a pumpable texture and very high baking stabilities can be reached. When using these pectins a separate addition of calcium is necessary. The product firmness as well as the desired baking stability can be controlled and standardized by the calcium dosage.

***Fruit fillings with low methylester H&F Classic Pectins***

Pectin Classic AB 903 can be flexibly used for fruit fillings for bakery products at different soluble solids contents. An addition of calcium salts is not necessary. Fruit fillings, which are produced with Pectin Classic AB 903 are characterized by their pumpable, reversible texture and a very fine, creamy texture with high yield point.





Herbstreith & Fox KG

## Recipe

### *Fruit filling*

Product **Pectin Classic AB 903**

9g	Pectin 5% (=1.0%)
400g	Fruit pulp
540g	Sucrose
200g	Glucose syrup (15% dextrose, 15% maltose, 13% maltotriose)
x ml	Citric acid solution 50% for adjusting the pH-value

Input:	approx. 1150g
Output:	approx. 1000g
TSS:	approx. 75%
pH-value:	3.4-3.5

### Procedure:

- A Mix pectin with approx. 100g sucrose (from total sucrose amount).
- B Stir mixture A into the fruit and boil until the pectin has dissolved completely.
- C Add the remaining sucrose and the glucose syrup and boil to final soluble solids.
- D Adjust the pH-value with citric acid solution.
- E Filling temperature approx. 50-60°C.

Recipe for baking stable fruit preparations with Pectin Classic AB 903

## SCHEMATIC *Production Process*

### ***Production technology using a vacuum scraped surface heat exchanger***

The production of baking stable fruit preparations with low methylester pectins is carried out in two steps in a both heatable and coolable vacuum scraped surface heat exchanger with double jacket.

As the processing takes place under reduced pressure in the closed boiler, this is a careful and economic technology.

With the installed vacuum, boiling time and boiling temperature during the gel preparation can be reduced decisively.

This results in the raw materials being exposed to an only small heating stress and the finished products will keep their optimal quality concerning appearance, colour and flavour.

In the first step the fruit, the added sugar types, calcium salts or other buffer salts are heated up to 70-80°C and mixed with the mixer.

The resulting fruit-sugar-mixture is sucked by means of a vacuum into the boiling apparatus. Then the pectin solution is added and while stirring with a stripper the mass is concentrated in the vacuum up to the final soluble solids content. Finally the acid is added.

Integrated processing refractometers and pH measuring devices guarantee an automatic control of soluble solids content and pH-value.

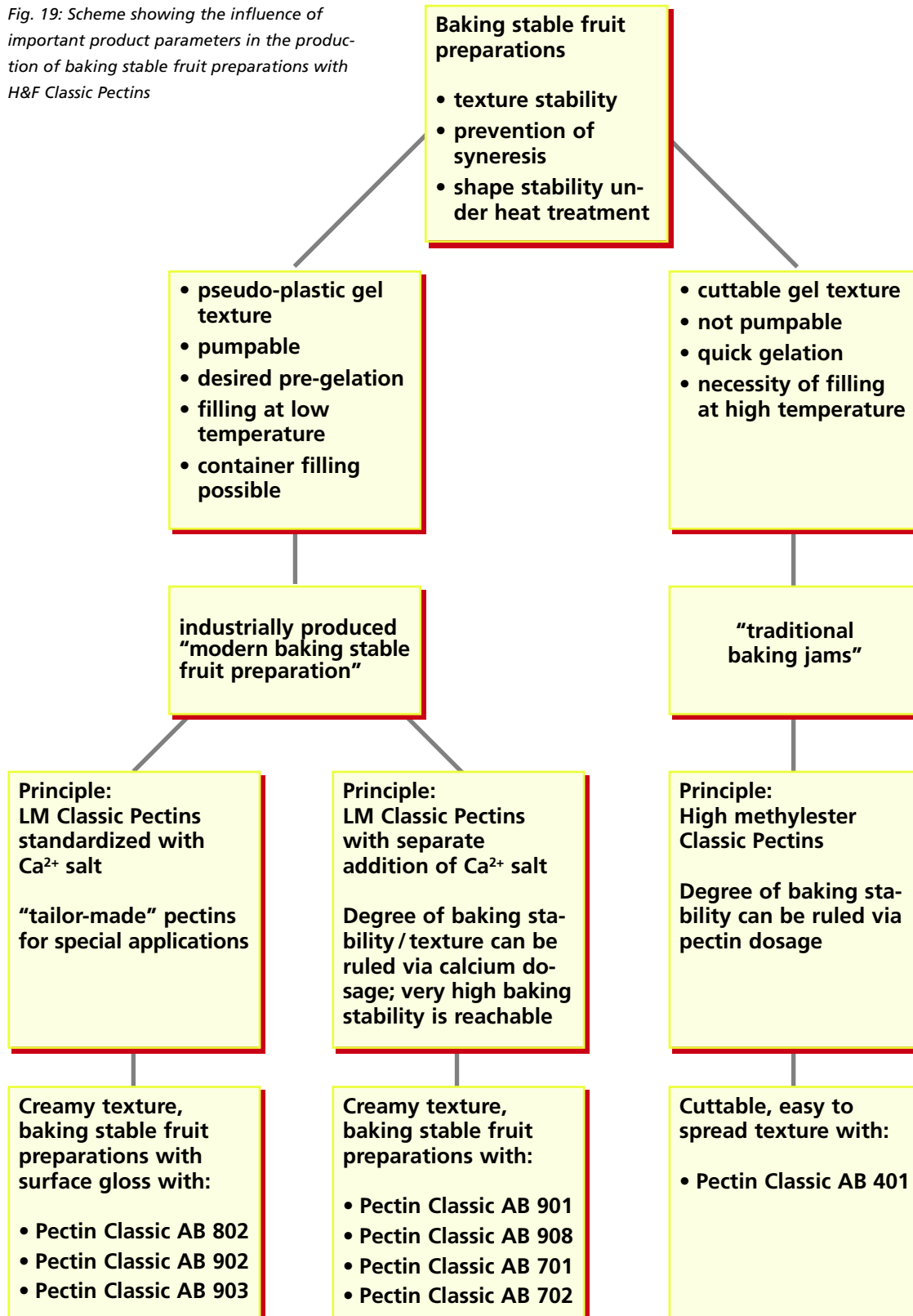
In the second step, the so called cooling phase, the product is cooled in the boiler under mechanical stress with the stripper until the desired filling temperature is reached.

Due to this mechanical stress the forming gel is permanently destroyed which results in a fine pre-gelation and a homogeneous and pumpable texture.

Usually the product is filled into containers at low temperatures. The filling temperature, however, depends on the respective container size.



Fig. 19: Scheme showing the influence of important product parameters in the production of baking stable fruit preparations with H&F Classic Pectins



## SPECIAL ADVANTAGES of H&F Classic Apple Pectins

### *Special advantages of H&F Classic Apple Pectins in the production of baking stable fruit preparations*

In the production of baking stable fruit preparations pectins are used as gelling agents and especially for means of water binding. In order to reach an optimal baking stability it is specifically important that a preferably homogeneous, visco-elastic gel network is formed. If the gel network is not formed homogeneously by the pectin and if particularly the necessary effect of water binding is not reached, the fruit preparation will not be baking stable which results in an undesired syneresis during processing and storage of the pastry.

*H&F Classic Apple Pectins already inherently have an optimal distribution of free carboxyl groups.*

Due to the naturally present enzyme activities in the apple raw material, the carboxyl groups are distributed statistically homogeneously. This is the reason why an excellent baking stability can be reached by using H&F Classic Apple Pectins.

*H&F Classic Apple Pectins are produced very carefully.*

The specific production technology of H&F Classic Apple Pectins realizes an optimal distribution of free carboxyl groups on the pectin molecule and with that a homogeneous esterification. The gel network is formed specifically homogeneous.

*H&F Classic Apple Pectins are characterized by a high water binding capacity.*

In fruit preparations for bakery products the gel network is stressed mechanically and destroyed partially already in the production process and during the following processing. The exceedingly high water binding capacity of H&F Classic Apple Pectins actively prevents the occurrence of syneresis which would affect baking stability and shelf life. The higher the viscous shares in the gel are, the more stable it becomes towards mechanical treatment and the lower then the tendency to syneresis is.

The ratio of viscous shares in a gel at otherwise the same recipe parameters is mainly determined by the raw material and the reactivity of the pectin towards polyvalent ions (mainly calcium ions).





Fruit preparations, produced with H&F Classic Apple Pectins therefore show very high stability towards mechanical and thermal treatment during processing, baking process and storage.

Viscous gels are industrially and also manually very well to process and please concerning sensory aspects above all by their exceedingly smooth and pasty texture. In contrast to Apple Pectins, Citrus Pectins form more brittle gels and are therefore only restrictedly suited for the production of baking stable fruit preparations.

*H&F Classic Apple Pectins have a standardized ion reactivity.*

In the production of baking stable fruit preparations for industrial processing a controlled pre-gelation is specifically effected by using low methylester pectins in order to obtain well processable products with smooth and pasty texture. Due to the standardized ion reactivity of the H&F Classic Apple Pectins this pre-gelation is easy to control during processing.

*Therefore baking stable fruit preparations which are produced with H&F Classic Apple Pectins are characterized by their homogeneous, smooth texture and their excellent baking properties. They also convince with a high stability towards mechanical stress and its extremely low tendency to syneresis.*

# PRODUCT RANGE – H&F CLASSIC PECTINS

*for baking stable fruit preparations and fruit fillings*

## Baking stable fruit preparations

Pectin	DE° [%]	Standardization with neutral sugars + composition	Charakteristics + properties	Main application
Classic AB 401	59-64	constant breaking strength E 440	Apple Pectin, baking stable gelled texture	Baking stable fruit preparations (TSS > 60%, pH 2.9-3.2)
Classic AB 701	36-44	constant calcium sensitivity, constant breaking strength E 440	Apple Pectin, very high baking stability in combination with separate calcium addition, short, dry texture	Baking stable fruit preparations (TSS 40-72%, pH 3.2-3.8)
Classic AB 702	33-39	constant calcium sensitivity, constant breaking strength E 440	Apple Pectin, high baking stability in combination with separate calcium addition, smooth texture	Baking stable fruit preparations (TSS 50-72%, pH 3.2-3.8)
Classic AB 802	38-44	constant calcium sensitivity, constant breaking strength E 440, E 341, E 450	Apple Pectin, smooth, pasty consistency, medium baking stability	Baking stable fruit preparations (TSS 40-72%, pH 3.0-3.8)
Classic AB 901	35-42	constant calcium sensitivity, constant breaking strength E 440	Apple Pectin, very high baking stability in combination with separate calcium addition, creamy pasty, smooth texture	Baking stable fruit preparations (TSS 40-72%, pH 3.0-3.8)
Classic AB 902	36-44	constant calcium sensitivity, constant gelling behaviour E 440, E 341	Apple Pectin, baking stable, pasty, pumpable texture	Baking stable fruit preparations (TSS 50-72%, pH 2.8-3.8)
Classic AB 903	37-44	constant calcium sensitivity, constant breaking strength E 440, E 331, E 341	Apple Pectin, baking stable, pasty, very smooth and pumpable texture	Baking stable fruit preparations (TSS 50-72%, pH 2.8-3.8)
Classic AB 908	32-36	constant calcium sensitivity, constant breaking strength E 440	Apple Pectin, very high baking stability in combination with separate calcium addition, pasty, smooth texture	Baking stable fruit preparations (TSS 40-72%, pH 3.0-3.8)

## Fruit fillings

Classic AB 803	36-44	constant calcium sensitivity, constant breaking strength E 440, E 341, E 450	Apple Pectin, pumpable, reversible	Fruit fillings for bakery products (TSS 40-72%, pH 3.0-3.8)
Classic AB 903	37-44	constant calcium sensitivity, constant breaking strength E 440, E 331, E 431	Apple Pectin, pumpable, reversible, very smooth, creamy texture	Fruit fillings for bakery products (TSS 40-72%, pH 3.0-3.8)







Corporate Group

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