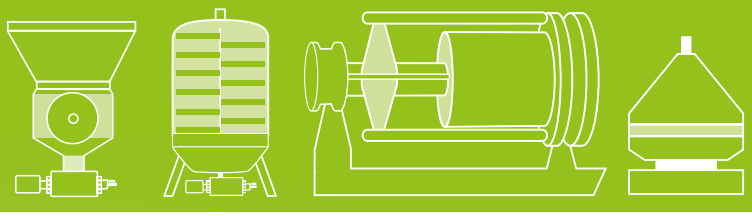
Modern apple processing



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Biochemical process during apple mash enzymation

Pectinases (as well as cellulases and amylases) are assigned to the hydrolase group. What these have in common is that they first hydrolyse their substrate and then break it down during another process stage. One example of this is pectinases which, depending on the ambient conditions (pH value, temperature, mash structure) first hydrolyse undissolved and unproblematic protopectin and simultaneously degrade hydropectin. Only this fraction causes a problem, as it increases the mash viscosity. Depending on the quality of enzyme used, there is a characteristic ratio to the pectin degradation. There are suitable application examples for both tendencies, i.e. the greatest possible selective degradation of hydropectin whilst retaining the protopectin and almost exclusive extrication of protopectins (maceration). Another important point is the external temperatures during fruit processing.

The minimum temperature for meaningful use of enzymatic processes in fruit processing is approx. 12 °C. Fruit for processing that has been in a cold store or picked at autumnal temperatures may be well below this. Processing businesses consider these facts and adapt their processes to the seasonal conditions.

Objectives of treating apple mashes

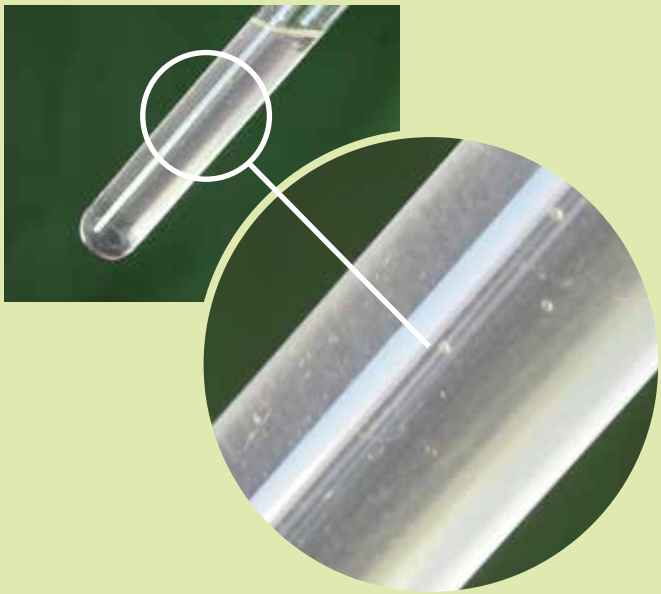
- High plant utilization
- Optimised juice yield
- High standards for colour, aroma and critical analysis parameters

METHOD 1:
Acceleration of free juice flow resulting in greater processing capacity for existing plants

This is achieved by a selective attack on the dissolved hydropectin. An apple mash's viscosity in the liquid phase is reduced; the juice drains well through the juice press even at the low pressure stage. This application can absolutely increase the total yield when using modern pressing systems and processing normally ripened apples. This application is particularly interesting when considering the improved pressability and optimum plant capacity utilization. Ideally, a pectin test taken straight from the press shows only slight residual pectin, in the form of single bubbles (see photo). This application's value ensues from the low physical pressing effort and the resulting improvement in juice quality and aroma.

Tools to optimise selective degradation of plant hydropectin

- Physical influence minimised through moderate enzymation temperature and less movement of the fruit mash
- Exclusion of secondary enzyme activity which promotes maceration by attacking cell tissue and the pectin molecule's hairy region
- Individual pectinase fractions are optimised, in order to exploit or exclude known synergy effects

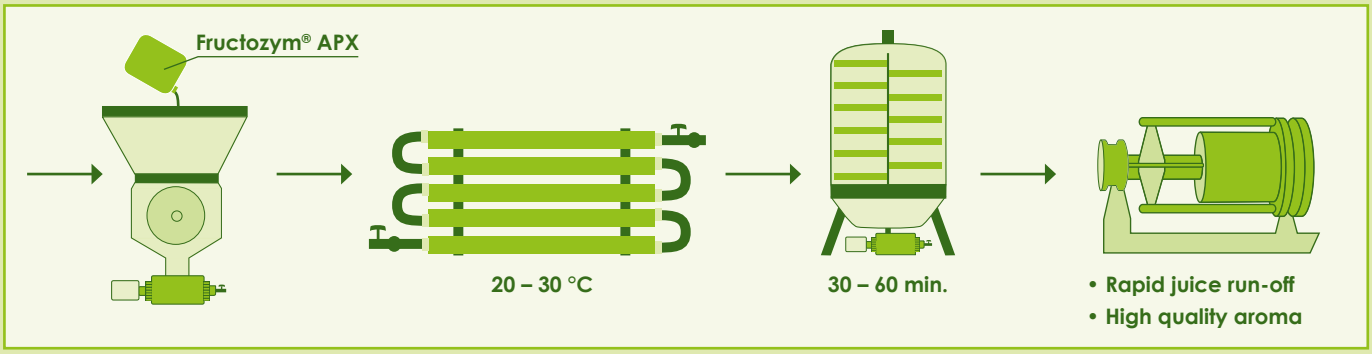


Particularly pure pectinases, as obtained from recombinant microorganisms, exhibit the best effect under these conditions. Application of Frutase EG PRESS produces a maceration effect which is slight when compared to simultaneous degradation of the hydropectin. This treatment achieves relatively good yields with optimum processing capacity. This is particularly apparent from the minimal release of colloids and low sediment content. Subsequent clarification and filtration is hardly affected.

METHOD 2:

Improved yield and good press capacity even for fully ripe to overripe fruit

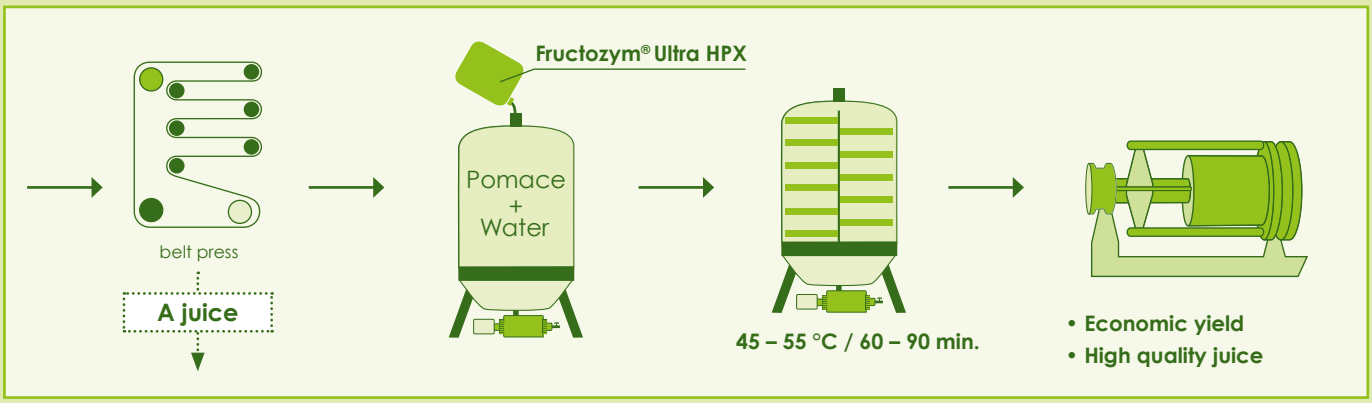
With increasing ripeness the apple starts to dissolve the cell tissue with its own enzyme systems. More protopectin, which provides structure, is released. The high purity pectinases discussed above no longer work effectively under these conditions. The reason for this is the pectin side chains, which have already been colloidally dissolved and which are now present in greater quantities. Capacity and total yield are significantly impaired if they are not broken down. What are known as "hairy region" pectins, such as rhamnogalacturonan and arabane increase viscosity and reduce the pectinase activity's efficiency. In these cases Fructozym® APX from a classically bred production strain is the right choice. More pectins with more complicated structures must be broken down in the mash's liquid phase. In the process the plant tissue should at most be loosened and not liquefied. Where juice yield is concerned, better results will be more reliably achieved with Fructozym® APX.



METHOD 3:

Distribution of the juicing process stage over two plant levels (Cascade)

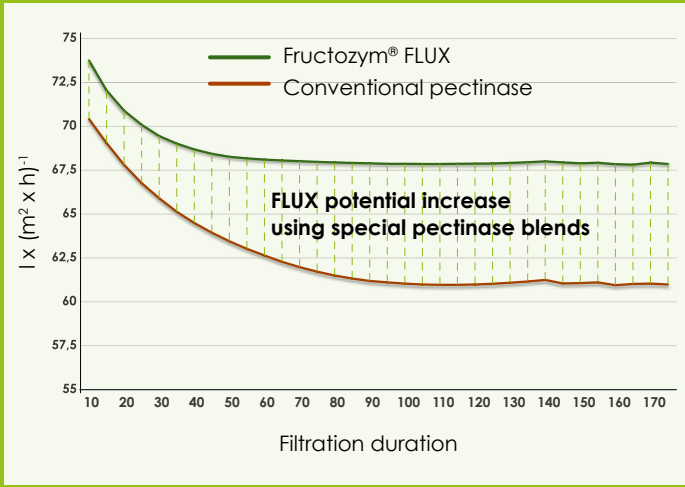
This strategy is very common in the AJC industry. The initial stage serves to achieve adequate processing capacity. The process can be optimised with enzymation at this stage given a suitable mash temperature. The subsequent extraction stage guarantees the plants' efficiency. Previously unavailable valuable ingredients and cell juice can be released at this stage. The effectiveness of the extraction enzyme is further increased with the rising temperature. New special pectinases, such as Fructozym® Ultra HPX, can easily be used close to their optimum effectiveness. This means that they are fully effective even at temperatures of up to 55 °C. At the same time this largely precludes a microbial infection in this case. This process facilitates excellent economic yields even if the initial conditions are unfavourable (overripe fruit).



Pectin degradation with the right flow

What are known as UF enzymes, such as Fructozym® FLUX, are a sensible supplement to pectin degradation alone. These are pectinases with a high content of accessory hemicellulitic activity, which counteracts "fouling", or development of an overlay which blocks the membranes. This becomes apparent from the stable filter flow rates above the reference level.

Fructozym® Flow UF is an exception to this. Accessory hemicellulitic activities such as arabanases and rhamnogalacturonases are combined in greater concentration with a fully fledged pectinase. The juice is usually perfectly prepared for filtration during routine pectin degradation. It is possible to treat very colloid-rich juices, such as tropical fruit juices like mango or pineapple, with Fructozym® FLUX. Fructozym® FLUX is also dosed before fermenting cider or fruit wine to reliably increase filtration performance of the crossflow filter used.



Overview of enzymation: pome fruits

Product	Description	Application	Dosage mL/1000 L or mL/1000 kg
Frutase EG PRESS	Highly concentrated pectinase for apple mash	Fresh apple	50 – 75
Frutase PL	Pure pectin lyase	Quick viscosity decline in the fruit mash and low formation of galacturonic acid in final juice	70 – 120
Fructozym® APX	Concentrated pectinase complex, non-macerating	Fresh and overripe apples, pears and quince, optimized press capacity	40 – 80
Fructozym® Ultra HPX	Pectinase and hemicellulase	Extraction of pome fruit and its pomace, maximum yield in the "cascade process"	80 – 150
Fructozym® Flot	Pure pectin methylesterase	Apple mash process with pomace drying	70 – 150
Fructozym® P6-L	Concentrated pectinase and arabanase for juice clarification	Pectin breakdown during juice concentrate production	5 – 30
Fructozym® P6-XL	Universal pectinase, highly concentrated	Pectin breakdown in NFC juices and juice concentrate production	5 – 30
Fructozym® Flow UF	Concentrated pectinase and hemicellulase	Pectin breakdown and improved filtration for all fruit juices	5 – 30
Fructozym® FLUX	Broad spectrum pectinase, rich in glucanase	Optimized fruit juice and cider filtration	10 – 50
EnerZyme® HT	Concentrated glucoamylase	Starch breakdown and saccharification	10 – 25
EnerZyme® Crystal	Amylase mix, heat and acid tolerant	Hot clarification up to 65 °C (149 °F) in very acidic products, saccharification of limit dextrins	5 – 25

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