



Citrus and tropical juice production

Oranges are one of the fruits most frequently grown in the subtropical and tropical zones. This goes hand-in-hand with the fact that orange juice is also drunk all over the world and excels apple juice consumption.

Citrus juices are mostly cloudy and based on reconstituted concentrates. Special products, such as clear stable juices, natural acidification, or peel extracts as natural cloudifiers for lemonades are becoming increasingly important.

In times of increasing labour, water and energy costs, extracting the maximum possible value from a fruit matters more and more.

Juice production is also increasingly focusing on other tropical fruits, such as banana, mango and guava, etc. Traditionally they are produced as purées, but clear juices and carbonated soft drinks with a tropical juice content are becoming popular all over the world.



Clear, stable tropical juices

Citrolase® TF Clear

Pectin degradation in tropical juices

Tropical fruits, such as mango, passion fruit, guava, pineapple, banana and cashew vary greatly in their sugar, acid and pH levels. They also vary in their consistency, which is mainly affected by different pectin levels and the content of celluloses and hemicelluloses, such as araban and mannan.

Citrolase® TF Clear is a unique pectinase formulation, which is enriched with special hemicellulytic activities to degrade pectin and hemicellulose in tropical fruit mash or purée for clear juice production. Even the stability of clear, stable tropical juice is significantly increased by full degradation of haze-forming polysaccharides from the pectin molecule as araban.

Citrolase® TF Clear

Special pectinase with hemicellulases for the production of clear, stable juice from tropical fruits. For de-pectinisation in mash, purée and juice.

CelluMASH

Long, food-grade quality cellulose fibres to improve yield for juice extraction with hydraulic press systems.

Juice extraction from purée

CelluMASH

Pressing aid for weak-structured mashes

The most common way to extract tropical juices is to use pasteurized purée and a decanter centrifuge. Purée itself has no structure and cannot be pressed with hydraulic presses as in the horizontal press system. Decanters can work with such unfavourable conditions, but show reduced yield.

CelluMASH increases yield and makes hydraulic press systems as flexible as possible. This special food grade cellulose fibre is distributed direct before press filling into the mash tank and generates the necessary structure during the press cycle.





Clear citrus juices

Clear, stable beverage blends for carbonated soft drinks are often acidified with clear lemon juice concentrate. With the low pH and high protein load, lemon juice in particular is difficult to stabilize and filter.

Also darkening during evaporation and stabilization can be a problem, especially when the final beverage must be very light.

A combination of the **Citrolase® TF Clear** pectinase formulation and **Fructozym® UF** shows significant improvements in the filtration and stability of lemon juice.

Fining with **Akticol FA-UF**, **Blancobent UF** and **Klar-Sol Super** reduces colour and protein. After cross-flow filtration, application of **Ercarbon SH** stabilizes colour during the evaporation process and reduces darkening afterwards.

Fructozym® UF

Pectinase with arabanase and acidic protease activity. Increased stability and filterability in clear citrus juice process and improved essential oil yields by better water-oil-separation.

Blancobent UF

Special bentonite, free from coarse particles. Designed for in-line stabilization in cross-flow filter systems.

Klar-Sol Super

Special acidic silica sol for protein, complexation at pH < 3.2.

Citrus processing

Orange and lemon are the two major products in the citrus juice industry. In addition, consumers are focusing more and more on lime, grapefruit and blood orange.

Akticol FA-UF

Acid activated, highly efficient activated carbon powder of plant origin

Ercarbon SH

Special steam activated plant based carbon. Adsorption of non-condensed polyphenols and thus colour stabilizing.

It is not only typical cloudy citrus juices and their concentrates that are interesting for the beverage and food industry, the non-edible part of the fruit is also of value and is used in different applications.

Production of clear, stable lemon juice concentrate

Cloudy lemon juice concentrate

All numbers calculated per ton resp. 1,000 L of juice

Water addition to 11–19 °Bx

Pectin and protein degradation
Juice vessel
<20°C | 12h
40°C | 2–4h



Citrolase® TF CLEAR
20–40mL
Fructozym® UF
15–20mL



Akticol FA-UF
200–400g
Blancobent UF
<500g
Klar-Sol Super
2–3L

Fining

Ultrafiltration

Precoat filtration



Ercarbon SH
200–400g

Sheet filtration

Evaporation



Starch degradation in tropical juices

Production of clear, stable mango juice concentrate with a horizontal press

Aseptic mango purée

All numbers calculated per ton resp. 1,000 L of juice

Optional:
water addition to
14 °Bx

Mash enzymation
Mash tank
55 °C | 2 h



Citrolase® TF Clear
150–250mL

Distribute shortly
before pressing
Mash tank



CelluMASH
10–15kg

Horizontal press

Aroma recovery

Juice enzymation
55 °C | 1–2h
Pectin and
starch degradation



Citrolase® TF Clear
20mL
EnerZyme® HT
10mL

Fining



FloraClair®
Tannivin® Galléol
Blancobent UF

Precoat filtration

Some tropical fruits, such as bananas or passion fruit, contain greater amounts of starch. It reduces membrane filter performance and impair the stability of clear products. Full enzymatic degradation is therefore necessary. Starch must be fully solubilised before its enzymatic degradation.

Enerzyme® ALPHA

Liquid highly concentrated amylase enzyme preparation for degradation of starch and dextrans.

Enerzyme® HT

Highly concentrated glucoamylase for the degradation of hydrolysed starch.

This is done by heat treatment above 80 °C.

EnerZyme® ALPHA is a heat-stable alpha-amylase with a good starch liquefaction effect for high levels of starch, or fruits with a low pH level (< 3.2). Full saccharification is carried out using the glucoamylase **EnerZyme® HT**.



Juice stabilisation

FloraClair®

The vegan choice for juice stabilisation

Clarification of tropical juice is often performed by physical separation, such as centrifugation and filtration. Fully automatic set-ups reduce labour costs, but do not safeguard colour or prevent subsequent haze formation.

The need for stable products can only be fulfilled by adding fining agents which adsorb polyphenols and protein. These components will cause browning and haze during the storage.

Classic fining with pork or bovine gelatine can be replaced by **FloraClair®**. Together with vegan fining partner **Tannivin® Galléol** and special bentonite **Blancobent UF**, this application is suitable for vegan, halal and kosher requirements.

FloraClair®

Vegetable fining protein. Tannin adsorption and beverage stabilization.

Tannivin® Galléol

Fully hydrolysable tannin from oak apples. Protein complexing and beverage stabilization.

It is possible to perform this stabilization using classic sedimentation or an in-line application during cross-flow filtration.



FloraClair® – the full alternative to gelatin for vegan fining

Preparation



FloraClair®



Water and
FloraClair® 10 : 1



Pre-swell
6 – 12 h



Stir before
partial addition

Phenol adsorption



Stir thoroughly 1 h

Flocculation aid

Tannivin® Galléol

Protein adsorption

Blancobent UF

Essential oil recovery

Fructozym® UF

Optimised essential oil yield

Depending on the extraction process, orange oil is removed from the peel before or during extraction. Essential oil is a valued ingredient for beverages, food and fragrances.

Mechanical brushing is essential before juice extraction to open the oil cells in the skin. Then the oil is extracted with warm water. The emulsion is centrifuged in steps to separate the oil from the water.

Fructozym® UF

Special pectinase-protease-preparation for citrus oil recovery.

Application of **Fructozym® UF** improves the separation of oil phase. The combination of arabanase and acidic protease improves the release of oil from the cells and phase separation in further separation steps. **Fructozym® UF** shows a great stability when recirculated with the extraction water.

Citrus oil production

All numbers calculated per ton resp. 1,000 L of juice

Finisher with deoiling step

Juice, pulps and peels

Oil wash water
20–55 °C

Enzymation vessel
20–25 °C | 30–60 min



Fructozym® UF
50 mL

Centrifuge /
hydrocyclone

Re-flow of
extraction water

Oil essence > 70%

Enzymation vessel



Fructozym® UF
200–300 mL

Centrifuge

Raw essential oil
99%

Dewaxing and
storage



Natural cloud systems

Carbonated soft drinks and lemonades live from their stable cloud. A homogeneous opalescence is one of the major quality criteria for a lemonade.

Natural cloud systems are produced from citrus peels. This natural pectin concentrate shows great possibilities for stabilizing haze in the final product. The unique formulation of lyase and hemicellulolytic activities in **Frutase® Citrus Cloudy** enables to extract as much very stable cloudiness from the peel as possible.

Frutase® Citrus Cloudy

Unique enzyme formulation with lyase and hemicellulase for the production of Natural Cloud Systems out of citrus peels.

Frutase® PL

Pure pectin lyase to reduce viscosity in fruit juices and extracts with reduced influence on stability and self-sedimentation.

It means that the cloudifier produced, does not separate during sedimentation. Before final concentration by evaporation, the cloud agent's viscosity can be individually adjusted by adding pure pectin lyase **Frutase® PL**. This activity does not affect the cloudiness itself and only reduces the viscosity for better handling.

Production of natural cloud systems

Orange peels after
juice extraction and
deooling

All numbers calculated per ton
resp. 1,000 L of juice

Grinding

50% H₂O, 80 °C

Pasteurisation
90 °C

For lemons optional,
for oranges mandatory

Enzymation vessel
45–50 °C | 20–30 min



Frutase® Citrus Cloudy
200mL

Decanter

Peel extract
~5 °Bx



Optional:
Frutase® PL
max. 30mL

Buffer vessel
90 °C

Viscosity reduction to individual
requirements

Optional: centrifuge

Evaporator to
~50°Bx

Overview

Enzymation: tropical fruits

Description	Application	Dosage*
-------------	-------------	---------

Degradation of pectins and colloids

Citrolase® TF CLEAR	Mix of pectinases with special hemicellulases	Clear juices of mango, banana, guava, papaya, etc.	10 – 500
Frutase® PL	Pure pectin lyase	Viscosity decline in cloudy citrus juices	10 – 30
Frutase® Citrus Cloudy	Pectin lyase and cellulase-hemicellulase	Extraction of citrus peels	20 – 200
Frutase® Soft	Concentrated liquid enzyme preparation with beta-glucosidase	De-bittering of citrus peel extracts and reduction of the bitter flavour in comminutes	50 – 150
Citrolase® TS	Purified pectinase	Reduction of viscosity in citrus-pulp-wash	10 – 50
Fructozym® P6-L	Concentrated pectinase and arabanase for juice clarification	Pectin breakdown in sour juices	10 – 30
Fructozym® FLUX	Broad spectrum pectinase, rich in hemicellulase and glucanase	Optimized filtering of fruit juice and cider; cleaning of cross-flow filter systems	10 – 50
Fructozym® UF	Pectinase and acidic protease	Improved stability at high protein levels	50 – 200

Starch breakdown

EnerZyme® ALPHA	Fungal alpha-amylase	Good effect at low pH-levels (< pH 3.2); prevention of filamentous cloudiness	5 – 200
EnerZyme® HT	Concentrated glucoamylase	Starch breakdown and saccharification	5 – 200

*g or mL/1.000 L



Overview

Clarification and stabilisation: tropical fruits

Description	Application	Dosage*
-------------	-------------	---------

Clarification and stabilisation

Akticol FA-UF	Activated carbon from plants for de-colouration of beverages, free from coarse particles	De-colouration and stabilisation in cross-flow filter systems	450 – 1500
Ercarbon SH	Activated carbon from plants for stabilization of beverages	Polyphenol adsorption and stabilisation of colour	200 – 500
Aktivit	Granulated bentonite for beverage treatment	Protein-fining and clarification	500 – 2500
Blancobent UF	Special bentonite, free from coarse particles	In-line stabilization in cross-flow filter systems	500 – 2500
Erbigel®	Fining-gelatine	Tannin adsorption	50 – 400
FloraClair®	Vegetable fining-protein	Tannin adsorption, suitable for Halal, Kosher and vegan products	50 – 600
Klar-Sol 30	Alkaline silica sol for beverage treatment	Complexation of protein and excess gelatin	1500 – 3500
Klar-Sol Super	Acidic silica sol for beverage treatment	Complexation of protein and excess gelatin at pH < 3.2	1500 – 3500
Tannivin® Galléol	Fully hydrolysable tannin from oak apples	Beverage-fining	20 – 50

Pressing aid

CelluMASH	Long-fibre cellulose for solid-liquid-separation	Pressing-aid for juice extraction from purée	1 – 3 %
------------------	--	--	---------

*g or mL/1.000 L



