YOUR CHALLENGES

- Growth control of yeast, mold, LAB and spores
- Stabilizing natural color (anthocyanins)
- Delay of rancidity
- Shelf-life extension
- Natural, friendly-label

CLEAN-LABEL HIGHLIGHTS

- Plantéria® CF Citrus extract
- Chitoly® AB Mushroom chitosan
- Mushria™ Mushroom extract
- Guardox™ BL Bamboo leaf extract
- Fixolor® AT Cultured sugarcane

BOOST MICROBIAL AND COLOR STABILITY IN BEVERAGE

Consumers are now demanding more flavored drinks with a longer shelf-life. However, long-term storage stability of sweet and slightly acidic beverages has always been problematic as bacteria, yeast and molds grow very well in such environments. Additionally, oxidation over time can result in flavor and color loss.

Traditionally, Ascorbic acid (E300-304) is used to prevent browning, off-flavor and discoloration in fruit juice; Citric acid (E330) is used to stabilize anthocyanins and prevent microbial growth; Potassium sorbate (E202) is used to prevent Alicyclobacillus spp. in soft drinks and fruit drinks; and Sodium benzoate (E211) is used to prevent LAB and yeasts in carbonated drinks.

Our natural solutions include Natap®, Epolyly®, NisinA®, NisinZ®, Lysoch®, Plantéria® CF, Chitoly® AB, Chitoly® OM, Mushria™, Guardox™, and Fixolor® AT have been developed effectively to control microbial spoilage and boost color stability in beverages.

APPLICATIONS

- Juices
- Soft drinks
- Beer
- Wine
2.1 Beverages-deterioration causes

2.1.1 Microbial control
New age beverages are more vulnerable to microbial spoilage due to the neutral pH, sweetness levels and the addition of plant extracts, vitamins, peptides or amino acids, and special fats or minerals. These include yeasts, molds and Gram-positive bacteria such as Alicyclobacillus acidoterrestris, Lactobacillus spp. and Leuconostoc spp.

Our solutions include Natap®, Epolyly®, NisinA®/NisinZ®, Lysoch®, Plantéria® CF, Chitoly®, and Mushria™, which are cost-efficient to prevent bacteria, yeast and mold in all kinds of beverages.

2.1.2 Color stabilization
Natural colors such as anthocyanins (natural red-purple) are commonly acknowledged as unstable by nature and can consequently provide reduction of color intensity or color change (browning) in beverages. Depending on various factors such as pH, temperature and light, anthocyanin stability in acidified beverages can be increased up to 50% with Fixolor® AT.

2.2 Case studies

2.2.1 Juices
The major elements of juices and juice-based beverages are sugars and organic acids, microorganisms which tolerate low pH and low water activity may survive and grow after pasteurisation. These include yeasts such as Saccharomyces, Candida and Hansenula spp., Zygosaccharomyces spp., molds such as Aspergillus, Penicillium and Byssochlamys, and Gram-positive bacteria such as Alicyclobacillus acidoterrestris, Lactobacillus spp. and Leuconostoc spp.

In addition, anthocyanins are unstable, oxidation will cause rancidity and browning in fruit juice and juice-based beverage. Natap®, NisinZ®, Chitoly® and Plantéria® CF have been used to control these bacteria, Fixolor® AT to stabilize the anthocyanins, and Guardox™ to delay rancidity in juice and juice-based beverages.

2.2.1.1 Apple Juice
Yeast (e.g. Saccharomyces cerevisiae), Gram-positive bacteria including LAB (e.g. Lactobacillus plantarum) and spores (e.g. Alicyclobacillus acidoterrestris) spoilage are the most important cause of apple juice quality loss during the shelf-life, especially for apple juice concentrate, browning will cause dark color.

Chitoly® AB is used as aid-processing which is effective against Total Plate Count (TPC) and browning, while Chitoly® OM shows the highly effective fining agent for apple juice, which can afford less than 15% turbidity products with 0.8 kg/m³ of Chitoly® OM after 120 minutes as shown on Figure 1.

Figure 2 shows that the addition of NisinZ® at a level of 6.25 mg/l can restrict the growth of Alicyclobacillus and prevent acidification in fresh apple juice which were stored at 21 °C.

2.2.1.2 Orange Juices
Orange juice is often subject to visible spoilage [surface growth or gas production] caused by a wide range of yeasts and molds.

The addition of 10 mg/kg Natap® at 80°C for 10 minutes had an immediate reduction effect on yeast and mold counts in orange juice. After 1 week of storage at 2.5°C to 4°C, yeast and mold counts were undetectable and the sample remained unspoiled for the 8-week duration of the test. Control samples were spoiled within 1 week.

Besides, 120 mg/L Guardox™ BL can resist oxidation of orange juice, make anthocyanin stable above 12 months at room temperature. While the control showed darkened color in the 8th month.
2.2.1.3 Carrot Juice
Carrot juice, like other fruit juices, has limited shelf-life, up to 10 days after processing. The microbial deterioration production of unpleasant odors and degradation of ascorbic acid are among the main causes for quality loss during the shelf-life.

Chitoly® AB effectively extended the shelf-life of carrot juice, by the control of acidity, browning and microbial growth during the storage times as shown on Figure 3.

2.2.1.4 Strawberry and raspberry juice concentrate
Figure 4 demonstrates the anthocyanin (color) stability impact of Fixolor® AT and citric acid in strawberry and raspberry juice concentrate. The result displays that Fixolor® AT significantly lowers the rate of color changing over time, compared with the sample acidified with citric acid.

2.2.1.5 Raspberry juice
And 50-100mg/L Plantéria® CF was added in bottled raspberry juice, the shelf-life increased up to 30 days, stored at 37 °C.

2.2.2 Soft drinks
Soft juice drinks can be spoiled by one or more yeast, bacteria and/or mold microorganisms. Spoilage tends to produce off-flavors, odors, and sedimentation. Yeasts such as Saccharomyces, Zygosaccharomyces, Candida, and Dekkera spp. are the most common. Also, acidophilic bacteria such as Lactobacillus, Leuconostoc, Gluconobacter, and Zymomonas spp. and molds like Penicillium spp. and Aspergillus spp., pose serious concern. Chemical preservatives, such as sodium- or potassium benzoate, have been rumored to contribute towards health problems.

Figure 5 shows that the addition of 150 mg/kg Mushria™ can effectively inhibit Total Plate Count (TPC) in soft juice drinks.

2.2.2.1 Water-based drinks
Non-carbonated water-based drinks such as apple juice drink, lemonade, orange drink, fruit punch, flavored fruit drinks, energy drinks, coconut, oatmeal, rice, sugar cane beverages and ready-to-drink tea, can succumb to microbial spoilage during ambient temperature storage. Yeast, Acetobacter and Gluconobacter commonly cause such spoilage.

Plantéria® CF is a perfect clean-label antimicrobial to inhibit these spoilage microorganisms in Non-carbonated water-based drinks.
BEVERAGE SOLUTIONS

2.2.3 Beer
Off-tastes and odors are produced mostly by wild yeast (e.g. Sacc. cerevisiae and Sacc. pastorianus), lactic acid bacteria (e.g. Lactobacillus and Pediococcus) and oxidation. In addition, strictly anaerobic Gram-negative bacteria including Pectinatus cerevisiiphilus and Megashaera spp. are becoming more and more important as beer spoilers.

Addition of Epolly® HCL is effective against yeast and LAB in beer, while Guardox™ BL can be used as antioxidant in beer.

2.2.4 Wine
During the wine making process, Malo-lactic fermentation induced by lactobacilli occurs very often. Lysoch® added in the process of wine brewing could not only inhibit the malo-lactic acid fermentation induced by lactobacilli, but also eliminates the harmful effect of lactobacilli. While addition of Chitoly® AB was effective in controlling Brettanomyces yeast infections of red wine.

In white wine, Lysoch® can be used jointly with SO2 to block the MLF. A 3-year testing in processes using Lysoch® have been proven to reduce 30 to 40 mg/kg of SO2. Sparkling wines treated with Lysoch® have a better production of bubbles than those that have not been treated with lysozyme.

The bentonite reacts with the Lysoch® administrated liberates some of the natural wine protein responsible for these small persisting bubbles.

Figure 6 shows replacing sulphur dioxide by 10 mg/L Lysoch® G4 has a similar control effect of LAB as 100 mg/L egg-white lysozyme in red wine.

Table 1. Natural Shelf-life Solutions for Beverage

<table>
<thead>
<tr>
<th>Applications</th>
<th>Benefits</th>
<th>Brands</th>
<th>Dosage</th>
<th>Labeled as</th>
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<tr>
<td>Beer</td>
<td>Delay of rancidity</td>
<td>Guardox™ BL</td>
<td>0.05 g/L</td>
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<td></td>
<td>Growth control of LAB and yeast</td>
<td>Plantéra™ CF</td>
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<td>Juice</td>
<td>Apple juice</td>
<td>Chitoly® AB</td>
<td>1.5 g/L</td>
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<td></td>
<td>TPC inhibition</td>
<td>Chitoly® OM</td>
<td>1.5 g/L</td>
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<td>Carrot juice</td>
<td>TPC inhibition</td>
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<td>2 g/L</td>
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<tr>
<td>Fruit juices</td>
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<td>Natap™</td>
<td>2-3 mg/kg</td>
<td>Natamycin</td>
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<td>Growth control of LAB and Bacillus</td>
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<td>30–60 mg/kg</td>
<td>Nisin</td>
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<td>Fruits and vegetables</td>
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<td>juice</td>
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<td>Orange juice</td>
<td>TPC inhibition</td>
<td>Chitoly® AB</td>
<td>1.2 g/L</td>
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<td>Strawberry and raspberry concentrate</td>
<td>Clarification</td>
<td>Chitoly® OM</td>
<td>1.2 g/L</td>
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<td>Soft drinks</td>
<td>Prevent Anthocyanin [color]</td>
<td>Fixolor® AT</td>
<td>0.13 ml/L</td>
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<td>Degradation</td>
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<td>Water-based drinks</td>
<td>Delay of rancidity</td>
<td>Guardox™ BL</td>
<td>0.015 g/L</td>
<td>Bamboo leaf extract</td>
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<td>(e.g. RTE-tea drinks)</td>
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<td>Mushria™</td>
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