Dow Pharma & Food Solutions

CLEAR+STABLE™
The clear choice for food and beverage stability

Dow Pharma & Food Solutions is dedicated to supporting the food and drink industry with a range of food ingredients designed to cater for the increasingly wide variety of consumer tastes and health demands. We are a multi-national, science-driven business, offering tailored formulation, application, quality and regulatory expertise to help enable the development of innovative food and drink products worldwide.
Introducing CLEAR+STABLE™ cellulose gums

The CLEAR+STABLE™ portfolio from Dow Pharma & Food Solutions is a range of cellulose gums (otherwise known as sodium carboxy methylcellulose (E466)) designed to bring excellent stability to acidified beverages, sauces and other products throughout their shelf-life.

Manufacturers looking for alternatives to pectin are increasingly turning to cellulose gums such as CLEAR+STABLE™, which not only offer thickening properties, but the ability to interact with proteins at low pH, preventing them from being lost as sediment. They are also convenient to use during processing as well as cost-effective.

**Key benefits of CLEAR+STABLE™ include:**
- protein protection in acidic dairy or soy-based products, for example in blends of fruit juices and dairy or soy milk
- excellent clarity in beverages at low pH
- stability during shelf life, even in acidic products.

**Key CLEAR+STABLE™ features**

| Excellent stability in acidic solutions (i.e pH 2.8 to pH 7) compared to regular CMC grades | Stable viscosity and transparency (no turbidity) during shelf life, increasing consumer appeal |
| Interaction with proteins at acidic pH | Prevents dairy and soy proteins from flocculating and leading to sediments at low pH levels |
| Neutral taste and calorie-free | No additional calories or flavors to the final product |

**Stability in acidic pH solutions**

Solutions of standard cellulose gum grade and CLEAR+STABLE™ 30,000 PA at 2% (both solutions at same viscosity range, preserved with 0.1% Sodium Benzoate) were acidified to pH 3 and stored for 5 days. As the image shows, the CLEAR+STABLE™ solution maintained clarity, whereas the standard cellulose gum solution began to show some turbidity.

**Stable viscosity**

CLEAR+STABLE™ also offers stable viscosity over time, as the graph demonstrates: solutions of 2% CLEAR+STABLE™ 30 PA were adjusted to pH levels of 2.5 and 3, and stored for 12 weeks. Viscosity was maintained.

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Internal tests, Bomlitz, December 2014

Internal tests, Bomlitz, October 2012
Protein protection
Whereas cellulose gum is primarily used as a thickener it also has the useful ability to interact with proteins at acidic pH. Pectin is the only other hydrocolloid with similar capability.

This ‘protection of proteins’ happens only at acidic pH levels via an ionic interaction which maintains the solubility of the proteins below their iso-electric point, preventing proteins from flocculating and dropping out of solutions as sediment.

As the images demonstrate, our tests have shown different CLEAR+STABLE™ solutions interacting well with dairy and soy proteins in applications such as milk/juice beverages.

Choose the right option for your acidic protein beverage!
CLEAR+STABLE™ is an easy to use and cost effective solution to stabilize proteins.

Internal tests, Bomlitz, November 2014
## CLEAR+STABLE™ properties in comparison with pectin and guar gum

<table>
<thead>
<tr>
<th>EU regulation / Labeling</th>
<th>CLEAR+STABLE™</th>
<th>Pectin</th>
<th>Guar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>E466 Sodium carboxymethyl cellulose Celulose gum</td>
<td>E440 Pectin</td>
<td>E412 Guar</td>
</tr>
<tr>
<td>Dissolution/Activation</td>
<td>Will dissolve in cold AND hot water</td>
<td>Will dissolve ONLY in hot conditions</td>
<td>Will dissolve in cold AND hot water, but gains most viscosity after heating</td>
</tr>
</tbody>
</table>
| Solution properties     | • Transparent solution  
  • Large range of viscosity available WALOCEL™: from 30 to 30 000 mPa.s at 2% concentration  
  CLEAR+STABLE™: 30, 100, 2 000 and 30 000 mPa.s at 2% concentration  
  • Completely neutral in taste | Solutions form in hot, at acidic pH or when not in the conditions for gelling.  
  Different viscosities available. | • Turbid solution  
  • Only high viscosity available (around 45 000 mPa.s at 2%)  
  • Gives a beany taste |
| Gelling properties      | No | Yes, through cooling down (when pH is acid and amount of soluble solid is high) | Yes, with Ca²⁺ ions |
| Protein protection      | Interaction with proteins at acidic pH via ionic interactions between Na-CMC and proteins | Interaction with proteins at acidic pH via ionic interactions between pectin and proteins | No |
| Other properties        | • Very good water retention properties  
  • Control of crystallisation during freeze/thaw cycles  
  • Stable at acidic conditions (down to pH =2,8) | • Increased viscosity when combined with xanthan or Na-CMC  
  • Good water retention capability and freeze-thaw stability  
  • Stable down to pH = 3 |
Putting it to the test!

Supporting producers of soy-based beverages
CLEAR+STABLE™ offers an efficient solution for manufacturers of acidic dairy and soy beverages. The grades – available in four viscosity ranges – support stability, not just during the production process, but during transport and all the way through to retailers’ shelves and beyond, helping to maintain consumer appeal. Not only that, but they also offer two key processing benefits:

1. CLEAR+STABLE™ grades are more cost effective than pectin in pasteurized and UHT products.
2. They are remarkably easy to use, demonstrating fast hydration in hot and cold water.

Don’t just take our word for it: take a look at the results of tests with CLEAR+STABLE™ during preparation of acidic soy beverages with common key ingredients and typical processing steps.

Test:
1. Soy milk was put into a beaker and stirred at 600 rpm.
2. CLEAR+STABLE™ and sugar were added as a blend, or pectin was added as a pre-solution (pectin was blended with sugar and dissolved in 80°C hot water).
3. The remaining ingredients were added.
4. The pH was adjusted to 4 with citric acid solution.
5. Pasteurization (80–90°C, 2 minutes) or UHT (130°C, 15 seconds) was carried out, with laboratory-scale HTST/UHT.
6. Homogenization (20°C, 200 bar) was completed.
7. The beverages were added into sterile bottles.

Table 2: Compositions of model beverages [w%] with CLEAR+STABLE™ and pectin

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy milk (3.7 % protein)</td>
<td>37.0</td>
<td>37.0</td>
<td>37.00</td>
<td>37.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Juice</td>
<td>17.5</td>
<td>17.5</td>
<td>17.50</td>
<td>17.5</td>
<td>17.5</td>
</tr>
<tr>
<td>Sugar</td>
<td>9.0</td>
<td>9.0</td>
<td>9.00</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>CLEAR+STABLE™</td>
<td>0.0</td>
<td>0.0</td>
<td>0.3</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>HM pectin</td>
<td>0.0</td>
<td>0.3</td>
<td>0</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Water</td>
<td>36.5</td>
<td>36.2</td>
<td>36.2</td>
<td>36.0</td>
<td>36.0</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.00</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Results

CLEAR+STABLE™ provides desired protein stabilization with at least 30% reduction in stabilization cost compared to pectin and also offer extra processing convenience.

Heat treatment*: Pasteurization

- F1. Without stabilizer
- F2. 0.3% HM pectin
- F3. 0.3% CLEAR+STABLE™

The beverages were stored at 4°C for one week. Samples were centrifuged at 1000 rpm for five minutes.

Heat treatment*: UHT

- F1. Without stabilizer
- F4. 0.5% HM pectin
- F5. 0.5% CLEAR+STABLE™

The beverages were stored at 4°C for one week.

Internal tests, Bomlitz, January 2012

Recommendations:

- HTST and pasteurization (<100°C, 2–30 minutes)
  - 0.3 – 0.4% CLEAR+STABLE™ 30 or 2,000 PA

- UHT (130°C, 15 seconds)
  - Homogenization after heat treatment or combined instrument
  - 0.5 – 0.6% CLEAR+STABLE™ 30 or 2,000 PA

*Data and pictures generated at Dow Pharma & Food Solutions’ specialist food and beverage research laboratory in Bomlitz, Germany. The Bomlitz manufacturing site has ISO 22000, PAS 22:2008, ISO 14001, ISO 9001 as well as Kosher and Halal certification. Visit www.pharmaandfood.dow.com for more details of certifications at Bomlitz and other sites.
**A range of solutions for great looking, high performing products!**

All CLEAR+STABLE™ grades are Kosher and Halal certified products, as well as allergen-, gluten- and GMO-free. They are available in different viscosity ranges and can support tailored formulation requirements for a range of food and beverage products:

<table>
<thead>
<tr>
<th>Viscosity Grade</th>
<th>Stabilization</th>
<th>Protein protection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td>- Acidic emulsions (e.g. aroma concentrates, basic emulsions for beverages, marinades)</td>
<td>- Acidic drinks – soy and dairy based</td>
</tr>
<tr>
<td>CLEAR+STABLE™ 30 PA</td>
<td>- Refreshment drinks based on fruit concentrates</td>
<td>- Dairy or soy with coffee</td>
</tr>
<tr>
<td>CLEAR+STABLE™ 100 PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>- Soups and sauces made with tomato concentrate</td>
<td>- Acidic drinks – soy and dairy based</td>
</tr>
<tr>
<td>CLEAR+STABLE™ 2,000 PA</td>
<td>- Marinades, dressings and dips</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Fruit syrups (max brix 60)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Sauces, ketchup, salsa (made with tomato concentrate)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Salad dressings</td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>- Drink concentrates</td>
<td>- Acidic drinks – soy and dairy based</td>
</tr>
<tr>
<td>CLEAR+STABLE™ 30,000 PA</td>
<td>- Emulsions (mayonnaise-based products)</td>
<td></td>
</tr>
</tbody>
</table>

*GMO-free are not intentionally added and are not knowingly introduced from another raw material.*
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