



# SUCROSE ESTERS AS $\text{TiO}_2$ REPLACER



## INTRODUCTION

Titanium dioxide (TiO<sub>2</sub>, E171) is a white colourant that is used in many different food stuffs, to bring whiteness and turbidity. Lately, health concerns have risen related to TiO<sub>2</sub>. In April 2019 the French Government decided, to ban E171 from any food product starting from January 1st, 2020. Also, the EFSA is looking critically to the safety of TiO<sub>2</sub>. Since then, producers of food products worked to suspend the use of E171.

## SISTERNA SUCROSE ESTERS

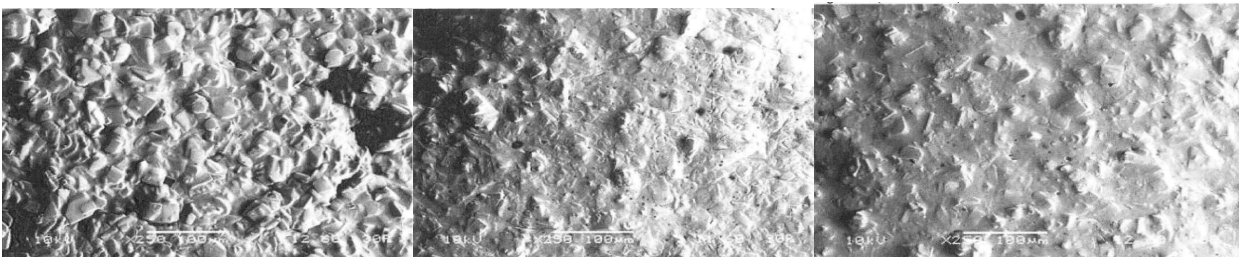
Sucrose esters are no colourants. Addition as such will not bring a white colour to food stuffs. Sucrose esters are soluble in water, thus will not contribute a lot to turbidity. Still sucrose esters can be a very useful help to replace TiO<sub>2</sub>. In general, the smaller a particle is, the lighter the colour will be. Smaller particles reflect the light differently, resulting in a white effect. Sucrose esters have the ability to reach very small particles in several food stuffs.

Sucrose esters are emulsifiers, which also have a unique effect on the crystallisation of sucrose and polyols. Sucrose esters inhibit the growth of existing crystals, forcing the cooling syrup to create more new crystals. For that reason, sucrose esters can bring a whiter colour to number of food stuffs, by:

- Creating smaller/more (sugar) crystals
- Creating smaller/more fat droplets
- Creating more/smaller air bubbles
- Preventing Maillard reaction

## CRYSTALLISED CONFECTIONERY

Sisterna sucrose esters affect the crystallisation of sucrose and polyols. This results in smaller and a larger number of crystals that are placed in a more stable crystal-network. The smaller crystals have a whiter effect, as the large amount of crystals reflect the light in a way that the appearance is brighter. This effect can be used in several types of high-sugar (or polyol) products like panned confectionery, fondant & icing.



Microscopic pictures of fondant *Blank*

*M*

*With Sisterna SP50*

*With Sisterna SP70*

## Panning confectionery

In panning we found that a dosage of 0.5% Sisterna SP50 results in the same whiteness as 0.4% TiO<sub>2</sub>.

The best grades to use for this application: Sisterna SP50 and SP70 for sugar confectionery, and Sisterna SP30 and SP50 for polyol (sugar-free) confectionery.



Left: with 0.25% TiO<sub>2</sub>

Right: with 0.5% sucrose esters

### Sugar-free (xylitol) Panning confectionery



A coating with xylitol is yellowish if no TiO<sub>2</sub> is used. Sucrose esters can help with a strong whitening effect.

Left: Xylitol coating with Sisterna SP50  
Right: Xylitol coating blank

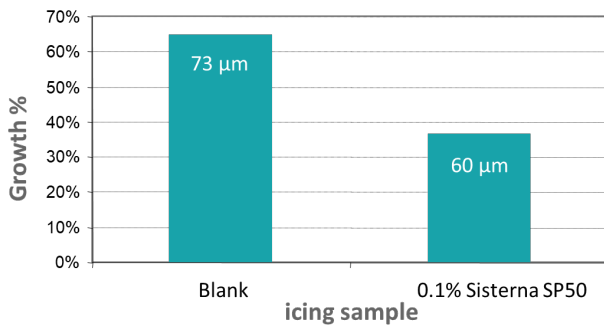
For more information check our TN Panning confectionery

### Fondant & Icing

Fondant with sucrose esters has a much whiter appearance, due to the smaller crystals, and possibly also due to incorporation of some air.

The best grade for this application: Sisterna SP50.

For more information check our TN Fondant & Icing.



Size of sugar crystals after 5 weeks storage. Initial crystal size was 44 µm



Left: Blank  
Right: with sucrose esters

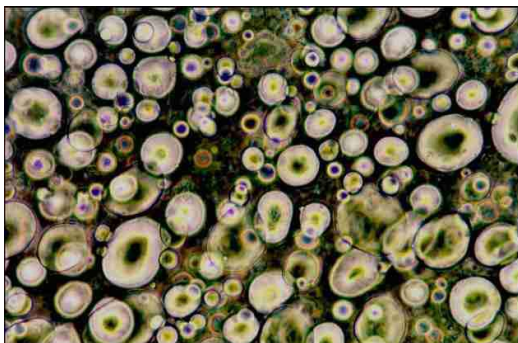


Left: Blank  
Right: with 0.5% Sisterna SP50

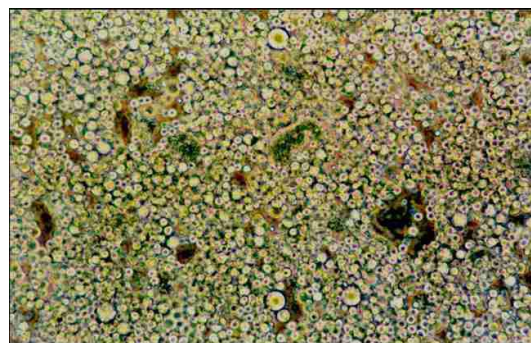
### OIL-IN-WATER EMULSIONS

Sisterna sucrose esters are water soluble and very powerful in decreasing the surface tension between water and oil. That makes them exceptionally good oil-in-water emulsifiers.

The use of sucrose esters in emulsions, will give very small and stable oil droplets, and this guarantees a lighter colour. The best grade to use for this application: Sisterna SP70.



Dressing 20% oil 1% MDG



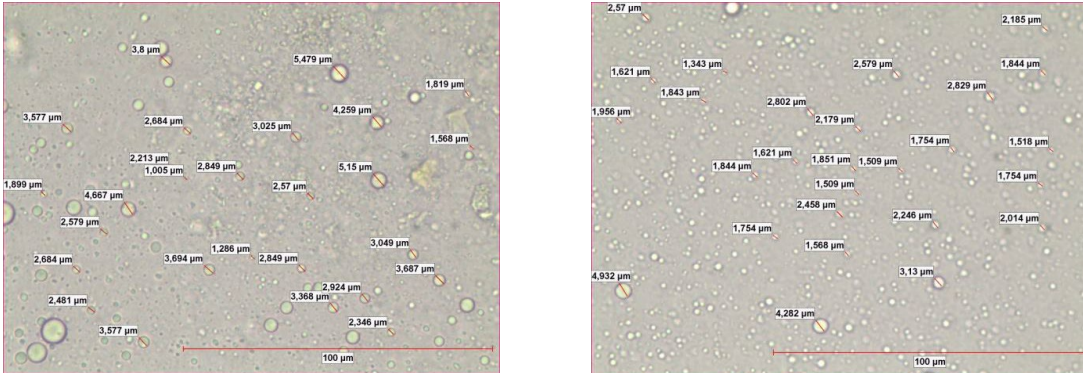
0.5% Sisterna SP70

For more information check our TN Emulsification.



### Milk alternatives

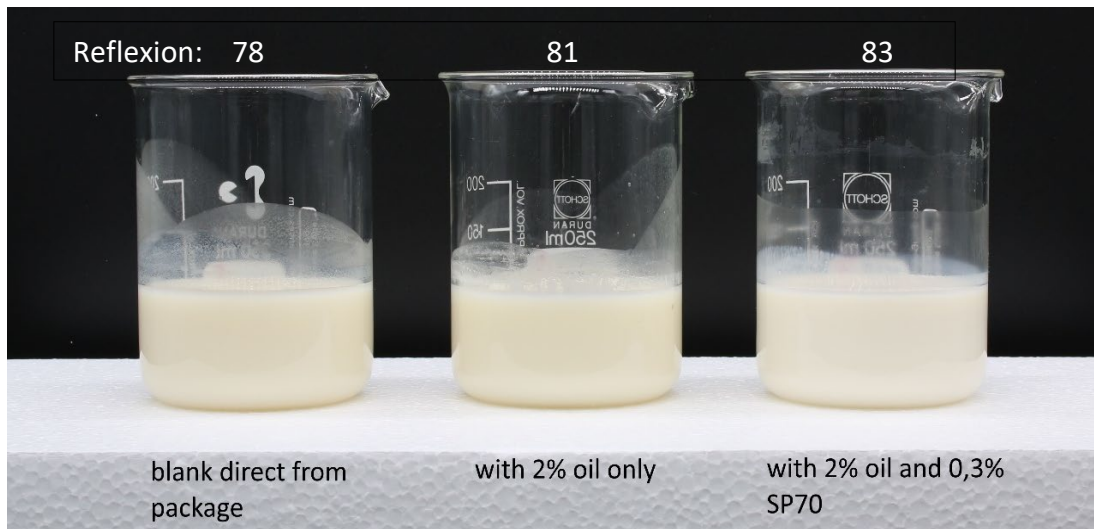
Milk alternatives contain little fat, what can lead to a somewhat transparent appearance. With sucrose esters this small content of fat can be dispersed so fine that the milk becomes whiter. Addition of extra fat is also possible.



Particle size oil droplets (µm)

Rice milk + 1% oil			Rice milk + 1% oil + 0.2% SP70		
Average	Minimum	Maximum	Average	Minimum	Maximum
2.21	1.01	5.15	1.40	0.92	2.61

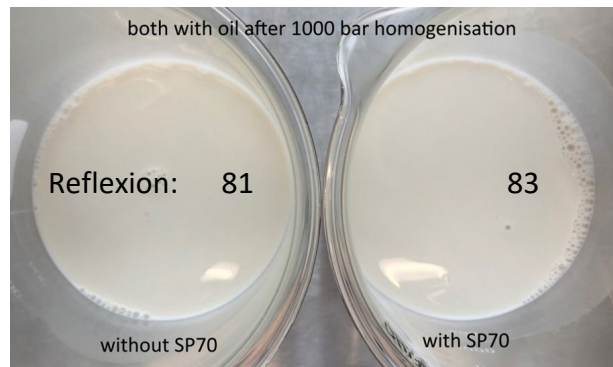
This effect becomes also clear in this picture:



Commercial oat drink. In the 2 right samples 2% oil is added, and heated to 70°C and homogenised at 1000 bar. The right sample is with 0.3% Sisterna SP70. Reflexion: the higher the value, the lighter the colour.

The pictures and the reflexion tests show that just adding oil and homogenisation will not result in a much whiter colour. Only with sucrose esters it is possible to reach such small oil droplets, and a whiter colour.  
Conclusion: with adding some oil, sucrose ester and high shear/high pressure, the colour of an emulsion becomes lighter.

For more information check our TN Milk alternatives.



## AERATED PRODUCTS

Products that are too thick to homogenise with a high-pressure homogeniser can become whiter by dispersing very fine air bubbles in the product. Sucrose esters are very effective in lowering the surface tension between water and air, thus can facilitate incorporation of many very small air bubbles. This large number of small bubbles reflects the light in such a way that the aerated product appears whiter. The best grades for aeration: Sisterna SP50 or SP70.

### Fillings

Fillings often contain a lot of fat. Sisterna developed two low-fat fillings, that can be aerated. Sucrose esters ensure that the fat droplets as well as the air bubbles are small. This results in a lighter colour.

To show the lightening effect of sucrose esters, the first filling was coloured with an orange colourant. The picture shows that the more air that is incorporated, the lighter the colour. Both fillings in the picture are aerated but the left one to a lower density.



**Aerated low fat filling**  
Density 0.61 g/cm<sup>3</sup> 0.69 g/cm<sup>3</sup>

A second filling is developed in order to reach a real white effect.

A basic filling recipe without fat was prepared and the whiteness was measured. Several additions in ingredients and processing were tried to reach a whiter end product. Besides colour also the density and texture are evaluated.

Ingredients Basic filling	%	Preparation
Corn syrup 40 DE	36	<ul style="list-style-type: none"> <li>Mix all dry ingredients</li> <li>Add dry mix to cold water and stir</li> <li>Add syrup (and fat) and heat to 70°C, while stirring</li> <li>Mix well in Hobart for 5 minutes</li> <li>Optional extra processing for whiteness</li> <li>When the filling has cooled down the viscosity reaches its final level</li> </ul>
Inulin fibre Frutafit HD Sensus	11	
Water	24.8	
Skimmed milk powder	14	
Sugar	12	
Carrageenan Ganulakta K100	0.2	
Starch Colflo 67	2	
Options to create whiteness	See below table	

Test	Options to create whiteness					Results		
	TiO2	Fat	Sisterna SP70	Shear	Aeration	Colour	Density	Texture
Blank	-	-	-	-	-	83	1.12 g/ml	Thick fluid
+ TiO2	0.2%	-	-	-	-	86	1.14 g/ml	Thick fluid
+ TiO2	0.4%	-	-	-	-	87	1.09 g/ml	Thick fluid
+ SP70 + Aeration	-	-	0.2%	-	Hobart wire whisk 8 min	88	1.05 g/ml	Thick fluid Foamy
+ Fat + SP70 + Shear	-	2%	0.2%	High shear mixer 600 rpm, 3.5 min	-	86	1.27 g/ml	Spoonable Stable Short
+ Fat + SP70 + Shear + Aeration	-	2%	0.2%	High shear mixer 600 rpm, 3.5 min	Hobart wire whisk 8 min	87	1.02 g/ml	Firm Stable Short Light

The test show that aeration with the help of sucrose esters creates a whiteness that is comparable to the addition of 0.2 – 0.4% TiO<sub>2</sub>. An overrun of 5% to 25% gives a very white effect, without making the filling very “foamy”. Adding extra fat that is sheared can also bring a lighter colour, but aeration is more effective. Moreover, adding fat to this recipe brings extra firmness to the filling and a short nice texture. The best results were reached by adding 0.2% Sisterna SP70 and 2% fat in combination with shear and aeration. A nice, firm and stable filling is formed with a very white colour.

For more information check our TN Aerated Low-fat filling, and our guide recipe B.29 White filling.

### Aerated fruit

Aerated fruit is a fruit preparation that can hold various quantities of air, just sufficient to match the density of for example yoghurt, or intensively aerated to create a fruit mousse. The picture shows both options. None of the aerated fruit preparations contains TiO<sub>2</sub>, but the whitening effect of aeration by sucrose esters is obvious.

For more information check our TN Aerated fruit.



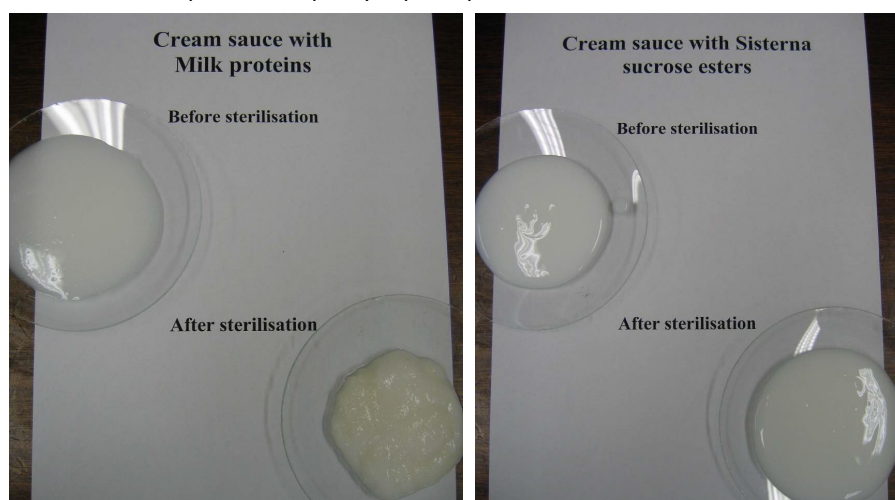
**Aerated fruit layer**  
Density 0.60 g/cm<sup>3</sup> 0.83 g/cm<sup>3</sup>

### MAILLARD REACTION

The Maillard reaction is a chemical reaction of proteins and sugars, that result in a brown colour. In case this reaction is unwanted, the proteins can be replaced by sucrose esters. Sucrose esters emulsify the fat or oil, just like proteins do, but they do not contribute to the Maillard reaction. This is another way to created whiteness by sucrose esters, without TiO<sub>2</sub>.

### Cooking cream sauce

In white sauces that contain herbs or mushrooms, the grey/brown colour formed in the Maillard reaction is unwanted. Think of sterilised creams sauces in a glass jar, or sauce that is meant to put on top of an oven dish. In these type of sauces often dairy proteins (milk powder) are used to emulsify the fat. Sucrose esters can also do this job. The pictures below, show that sterilising a cream sauce with sucrose esters instead of milk proteins, results in a nice white sauce. Moreover, the texture of the sauce remains smooth and homogeneous. Of course, it is also possible to partly replace proteins with sucrose esters, if some browning is wanted.



For more information check our TN Cooking Cream Sauce.

*Cream sauce before and after sterilisation. Left: with milk proteins. Right: with Sisterna SP70*

### Warranty

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