KRYSTAR®
Crystalline Fructose

TATE & LYLE

Desired sweetness level with fewer calories

Can be used to lower sugar and calories while delivering great taste

Fructose is the sweetest of all the naturally-occurring carbohydrate sweeteners. As a formulator, this means you can reach your desired sweetness level with fewer sugars and calories. It is a sugar found naturally in many foods we eat like fruits, vegetables, and honey. Fructose has many unique functional and nutritional properties that make it a valuable food ingredient.

In fact, it is more than a mere nutritive sweetener; it is a stand-out ingredient that delivers incredible functionality, superior sweetness, flavor enhancement and much more.

Crystalline fructose is a multi-functional sweetener with a broad range of application-specific benefits that provide consumer appeal.

Sweeter than sweet

Both KRYSTAR® and FRUCTOPURE® crystalline fructose have a sweetness potency of 117 compared to sucrose at 100 and dextrose at 67. In addition to a higher potency, fructose is also much more intense, as it delivers a far faster sweetness response than sucrose or dextrose.

Benefits

- Ability to reduce total calories when substituted
- Potential ability to reduce cost (depending on sugar price)
- Additional browning functionality for baked goods

Ultimate sweetness synergy

KRYSTAR® and FRUCTOPURE® Crystalline Fructose offer superior sweetness synergy in blends with nutritive sweeteners and high intensity sweeteners. Depending on the formula, a 50/50 blend with sucrose has a relative sweetness of 128 and can reduce calories by up to 28%.

Benefits

- Allows formulators to reach the same sweetness at lower ingredient use levels
- Contributes to lower calories and lower added sugars on the ingredient label

PRODUCT	SWEETNESS	SWEETNESS CONTRIBUTION RATIO	FRUCTOSE %	SPLENDA® SUCRALOSE (PPM)
KRYSTAR®/FRUCTOPURE® Sucrose (50/50)	128	100:00	8.54	0.00
Fructose	117	75:25	5.49	46.40
HFCS-90	106	67:33	4.82	60.24
Sucrose	100	50:50	3.27	83.02
HFCS-55	99	33:67	2.35	120.96
HFCS-42	92	25:75	1.74	132.50
Dextrose	67	–	–	–

In a blend of 50/50 fructose and sucrose, KRYSTAR® and FRUCTOPURE® achieve 28% more sweetness

Lower glycemic response

Both KRYSTAR® and FRUCTOPURE® Crystalline Fructose have a low glycemic response (GR) of 15. Consumption of foods containing fructose leads to a lower blood glucose rise compared to food containing sucrose and glucose. The low GR is particularly interesting for people with diabetes. It is also beneficial in sport, breakfast and children's products.

Benefits

- Offers lower blood glucose rise

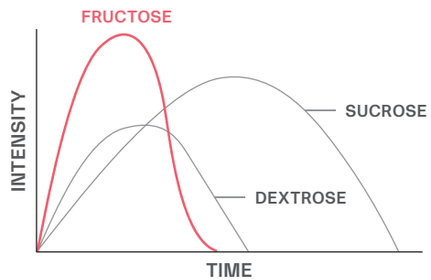
DIETARY SUGARS	GR VALUE
Fructose	~15
Glucose	100
HFCS	62
Honey	75
Lactose	90
Maltose	108
Sucrose	60

Faster sweetness response

Fructose has a unique sweetness response compared to other sugars like sucrose or dextrose. Sweetness appears very quickly, is very intense and then dissipates quickly to provide a very clean, refreshing mouthfeel with no aftertaste. This gives you the opportunity to formulate products with reduced levels of added flavors and other ingredients, which can provide a cost benefit.

Benefits

- Flavor enhancement of 15% or more particularly with fruit, chocolate and caramel notes, providing opportunities to reduce added flavor levels
- Clean taste with no aftertaste
- Masking of off-notes/bitterness



Reduces the glycemic response by 81%

Longer shelf life/improved humectancy

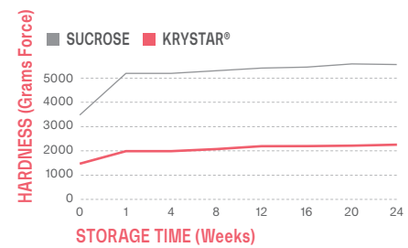
By reducing crystallization risk and controlling moisture migration, fructose can extend the shelf life of your product. Fructose is one of the most effective monosaccharides for binding moisture. It provides excellent humectancy to maintain a soft and chewy texture over time without hardening.

In a sample granola bar, substituting KRYSTAR® for honey and brown sugar reduced water activity to 0.48 from 0.56—and held the moisture content at just 4.8%. The features of KRYSTAR® and FRUCTOPURE® Crystalline Fructose provide the ideal combination for many baked goods and other intermediate moisture applications: Low tendency to recrystallize; High solubility; Superior humectancy.

Benefits

- Improved texture and mouthfeel
- Extended shelf life by ~10%

Granola bar hardness over time



Superior solubility

KRYSTAR® and FRUCTOPURE® have one of the highest solubilities of any sweetener—twice the solubility of sucrose—plus a very low A_w value.

Benefits

- Ideal for liquid applications such as beverages
- Easy to work with

	WATER ACTIVITY (A_W)	SOLUBILITY (G)
Fructose	0.634	4.00
Sorbitol	0.725	2.70
Sucrose	0.844	2.07
Dextrose	0.891	1.04
Lactose	0.931	0.23
Maltose	0.952	0.85
Mannitol	0.977	0.22

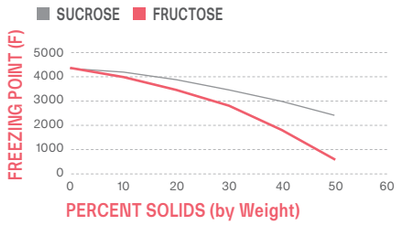
Water activity of the saturated solutions ($A_w=R_h/100$) and solubility at 25°C of various sugars and sugar alcohols.

Freezing point depression

By using fructose in your ice cream or frozen yoghurt formula, you can deliver a smooth, flavorful product that is easier for consumers to scoop, even at very low temperatures. Sucrose also depresses the freeze point in frozen dairy items, but as the graph to the right shows, fructose does it more effectively, and at an increased rate and at higher inclusion rates.

Benefits

- Lowers freezing point, yielding a more "scoopable" product
- Inhibits crystallization
- Delivers increased sweetness at lower temperatures



Summary of key benefits of KRYSTAR® and FRUCTOPURE®

Crystalline Fructose offer far more than just sweetening as a key component to sugar and calorie reduction solutions:

- Alone, they deliver 17% more sweetness than sucrose
- A blend of 50/50 fructose and sucrose achieves 28% more sweetness than sucrose alone, enabling lower calories and lower added sugars on the ingredient label
- Reduce the glycemic response by 81% compared to glucose
- Enhance flavor perception by 15% or more depending on the application
- Increase humectancy and shelf life by 10%
- Provide exceptional solubility for use in beverages
- Depress freezing point by as much as 40% versus sucrose

Depress freezing point by as much as 40% versus sucrose

Partner with Tate & Lyle, the global leader in crystalline fructose:

- First to commercialize crystalline fructose in 1985
- Owns or distributes a significant portion of the fructose supply globally
- Two wholly owned crystalline fructose production facilities operating on corn in North America and a preferential long-term distribution arrangement for European production on Non-GM corn
- Available as Non-GM FRUCTOPURE®
- Offers various crystalline forms for optimal flow and handling properties:

KRYSTAR® and FRUCTOPURE® Crystalline Fructose portfolio

KRYSTAR® 300	Crystalline	Min 99.5	Medium	–
KRYSTAR® 300U	Crystalline USP Grade	Min 99.5	Medium	–
KRYSTAR® 450	Crystalline	Min 99.5	Coarse	–
PWD KRYSTAR®	Crystalline	Min 98.0	Fine	–
KRYSTAR® 300 LIQ	Liquid	Min 99.5	–	77.0

FRUCTOPURE® 500	Crystalline	Min 99.5	Medium	–
FRUCTOPURE® 700	Crystalline	Min 99.5	Coarse	–
FRUCTOPURE® 211	Liquid	Min 95	–	70.5
FRUCTOPURE® 810	Liquid	Min 99	–	70.5
FRUCTOPURE® 260	Liquid	Min 95	–	80
FRUCTOPURE® 860	Liquid	Min 99	–	80

KRYSTAR® and FRUCTOPURE® Crystalline Fructose key applications

- Beverages (Flavored water, CSD, Sports drinks, Natural shakes, Alcoholic drinks)
- Confections
- Breakfast cereals
- Cookies/Muffins/Bars
- Yogurt
- Bakery filling/Fruit prep
- Pet food
- Tabletop sweeteners

About Tate & Lyle

We are a leading global food and beverage ingredients and solutions supplier, with a 160-year history of ingredient innovation. Through our purpose, *Transforming Lives Through the Science of Food*, we believe that together, we can successfully grow our businesses whilst having a positive impact on society. Partner with us to create healthier, tastier and more sustainable food and beverage solutions for consumers.

For more information, please visit us at tateandlyle.com