



NutraFlora

PREBIOTIC • SOLUBLE FIBER

Technical Booklet



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1. Product Characteristics

1.1 Definition

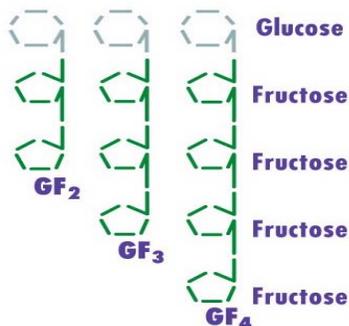
NutraFlora[®] short-chain fructooligosaccharides (scFOS[®]) natural prebiotic fiber is derived from beet or cane sugar using a patented enzymatic process and non-GMO ingredients, resulting in the highest concentration of pure scFOS on the market. The scFOS found in NutraFlora occur naturally, in small concentrations, in a variety of fruits, vegetables, and grains, such as bananas, barley, garlic, onions, honey, rye, brown sugar, asparagus root, and wheat. NutraFlora is an easy way to deliver the advantages of soluble fiber, numerous health benefits and the technical superiority of the most effective prebiotic ingredient.

1.2 Molecular Weight

The average molecular weight of NutraFlora depends on the composition of GF₂, GF₃ and GF₄. A standard sample of NutraFlora has a molecular weight of about 627 g/mol.

1.3 Chemical Structure

The scFOS in NutraFlora consist of glucose terminated molecules with two to four fructose units attached by β(2-1) glycosidic linkages to form GF₂ (kestose), GF₃ (nystose) and GF₄ (fructofuranoslynystose).



1.4 Health Benefits

The safety and effectiveness of NutraFlora are built on a foundation of more than 200 scientific studies.

NutraFlora's health benefits include:

- Promoting the growth of probiotic microflora in the colon
- Enhancing the absorption of minerals, especially calcium and magnesium
- Reinforcing immunity
- Improving digestive function

NutraFlora is a non digestible, soluble prebiotic fiber that passes intact from the mouth through the small intestine. Once in the colon, the scFOS are selectively fermented by beneficial bacteria – *Bifidobacteria* and *Lactobacilli* – into short-chain fatty acids (SCFA). Production of SCFA in the colon is associated with immune health support, improved digestive health, regularity, and enhanced nutrient absorption.

NutraFlora is non-cariogenic.

Streptococcus mutans is generally accepted to be the principal cause of dental caries. The Ikeda 1982, 1983 and 1990 studies show that scFOS do not promote the growth of *S. mutans*.

Furthermore, NutraFlora has been shown to increase mineral absorption and provide significant positive bone effects in combination with calcium. NutraFlora works synergistically with soy isoflavones, enhancing bioavailability of genistein and daidzein and improving bone mineral density.

Since NutraFlora is only metabolized in the colon by the beneficial bacteria, it does not generate changes in blood glucose levels or promote the secretion of insulin. Therefore, NutraFlora is completely safe for diabetics.

Figure 1. Effects of NutraFlora on Blood Glucose

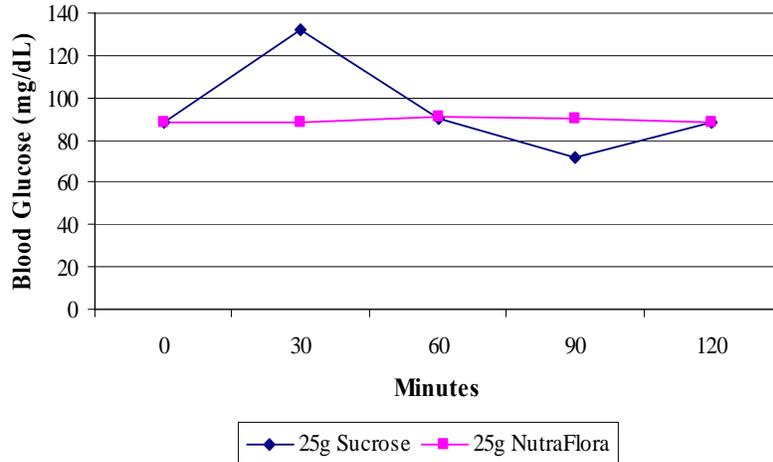
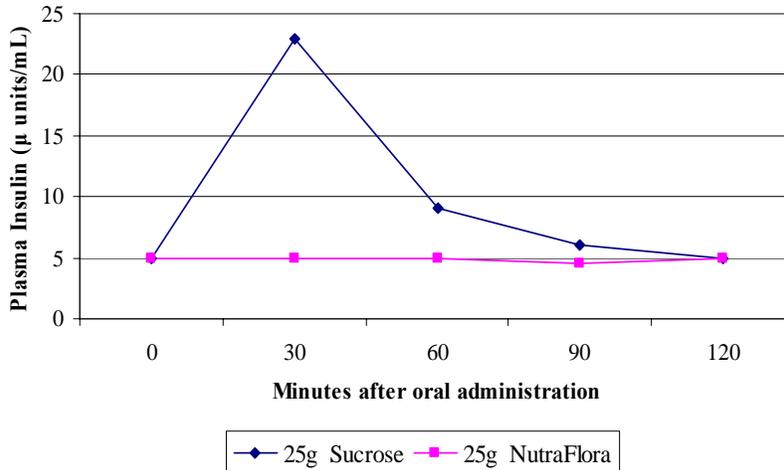


Figure 2. Effects of NutraFlora on Plasma Insulin



2. Technical Properties

2.1 General

NutraFlora is a highly effective prebiotic fiber that can be used in a variety of foods and supplements at very low inclusion rates, preserving taste, texture and mouthfeel. In addition, NutraFlora is highly soluble, heat stable, has good humectant properties, enhances flavors, masks off-notes, and extends the shelf-life of products.

NutraFlora has a mildly sweet, clean taste and can be added to both sweet and savory products by replacing small quantities of sweetener, flour or bulking agents.

2.2 Relative Sweetness

NutraFlora provides 30% the sweetness of sucrose (Table 1).

Table 1. Relative Sweetness

Product	Sweetness Level (%)
Sucrose	100
Fructose	120
Glucose	80-100
NutraFlora	30
Lactose	20-30

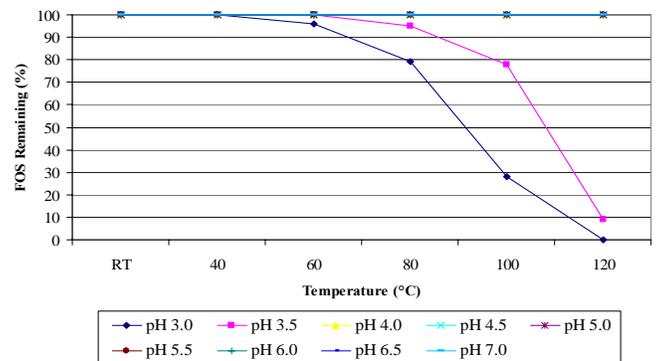
2.3 Solubility

NutraFlora is cold and hot water soluble up to ~80%. Solubility is almost identical to sucrose at typical use levels (below 10%). To reduce dissolution time NutraFlora P-95 can be dry blended with other powders in the formulation or heat can be applied.

2.4 Stability – pH and Temperature

The stability of NutraFlora is dependent upon solids content, time, temperature and pH parameters. At low solids content, low pH and high temperatures, the scFOS are hydrolyzed into residual sugars such as sucrose, glucose and fructose.

Figure 3. Temperature Stability

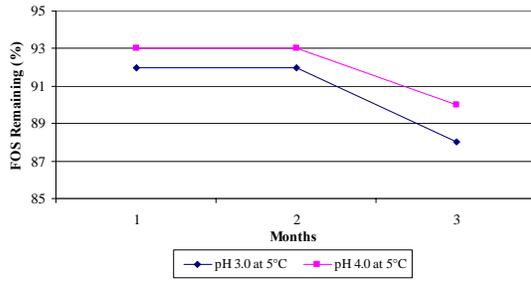


Holding time: 8 minutes

No significant degradation of total scFOS content is shown for samples at a pH above 4.0. However, partial degradation of GF₄ molecules can be seen at pH 4.0 and 60°C. Depending upon the application and processing conditions, degradation during shelf-life in acidic matrices can be prevented by the high solids content in confectionery-type applications and storage at low temperatures in high moisture systems.

NutraFlora remains stable at low pH if stored at temperatures that are relatively low (i.e. refrigerated or frozen conditions). For storage temperatures below 5°C and at a pH range of 3.0-4.0, scFOS are stable for ~ 3 months.

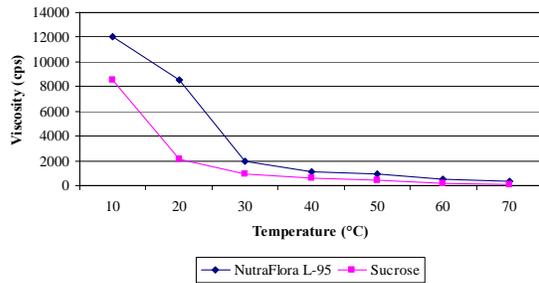
Figure 4. Stability at 5°C



2.5 Viscosity

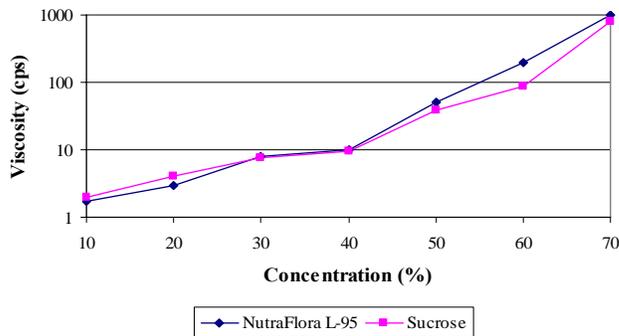
NutraFlora improves texture, mouthfeel and enhances cohesion of food products.

Figure 5. Effects of Temperature on Viscosity



NutraFlora has a short chain structure, thus, it behaves much like sucrose in food applications.

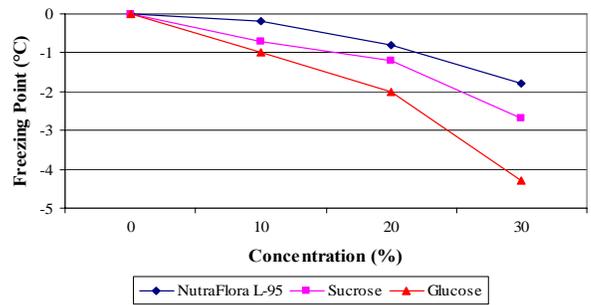
Figure 6. Viscosity of NutraFlora relative to Sucrose



2.6 Freezing Point

NutraFlora balances the freezing point, allowing for smoother texture of sherbets, ice creams and other frozen desserts.

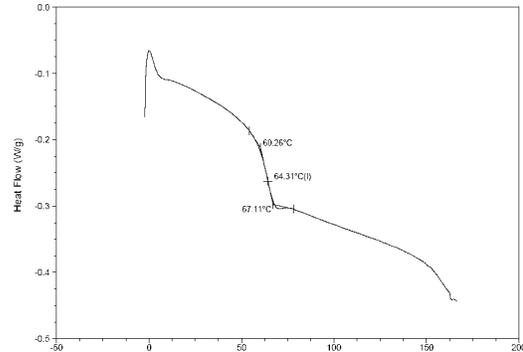
Figure 7. Freezing Point Depression



2.7 Glass Transition Temperature

The glass transition temperature of NutraFlora is 64.58°C

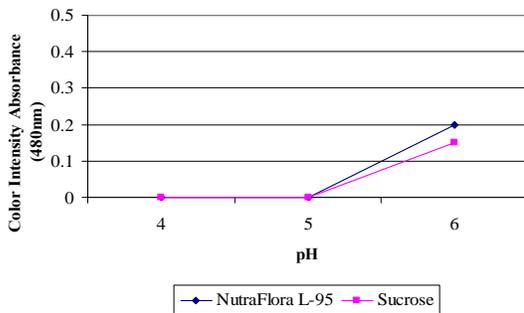
Figure 8. Glass Transition Temperature



2.8 Maillard Reaction

The scFOS in NutraFlora are glucose terminated and non-reducing. NutraFlora does not participate in the Maillard reaction, preserving protein quality and color of the finished application. Chicory derived products and oligosaccharides manufactured through enzymatic hydrolysis contain fructose terminated molecules that undergo Maillard browning.

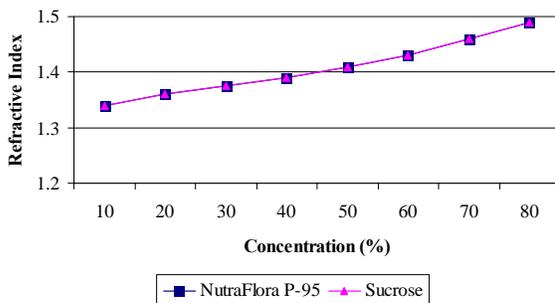
Figure 9. Maillard Reaction



2.9 Refractive Index

The refractive index for NutraFlora is identical to sucrose.

Figure 10. Refractive Index



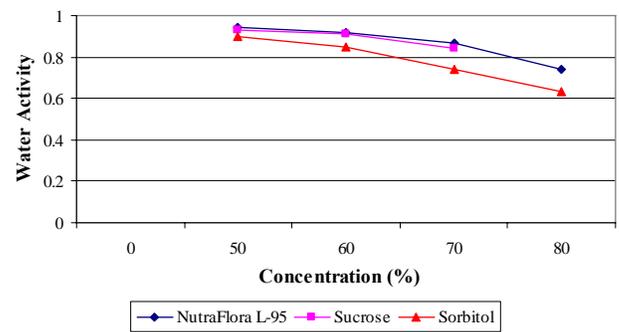
2.10 Density

NutraFlora is suitable for supplement applications. The density of NutraFlora is ~0.59 g/ml tapped and ~0.57g/ml loose.

2.11 Water Activity

The water activity of NutraFlora L-95 is similar to sucrose. Typical water activity for NutraFlora P-95 is between 0.1-0.2.

Figure 11. Water Activity of NutraFlora

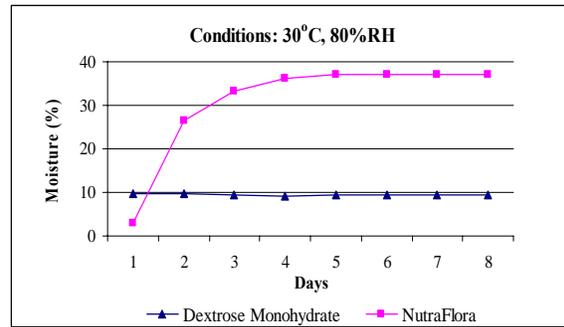
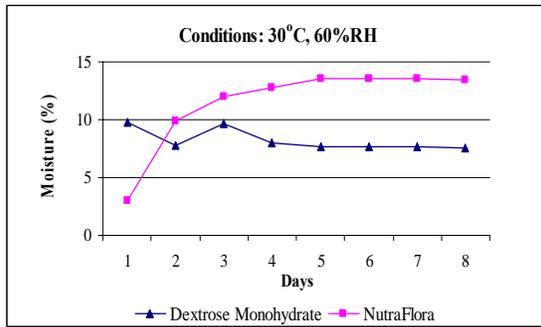
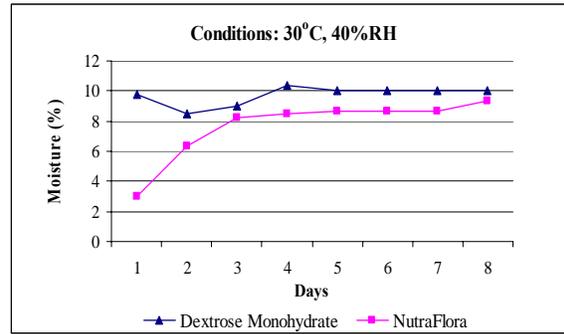
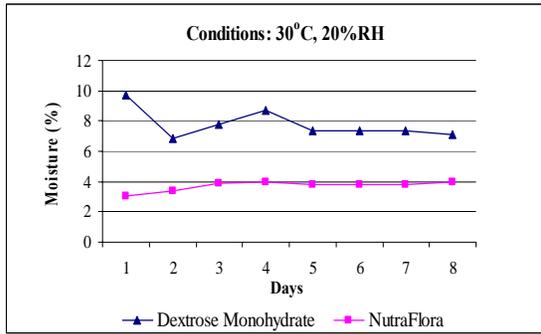


2.12 Caloric Value

NutraFlora contributes 1.5 kcal/g (Hosoya, 1988) and therefore can be used in reduced calorie applications, including sugar free products. The calories are derived from the small amount of residual sugars in the product and the fermentation of scFOS into SCFA.

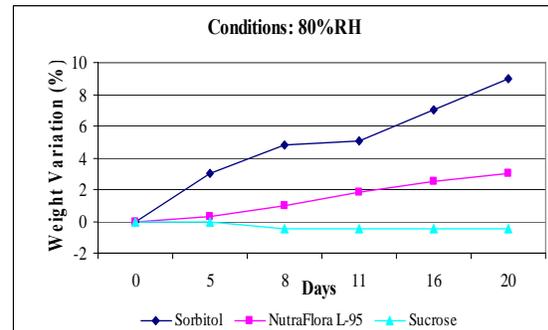
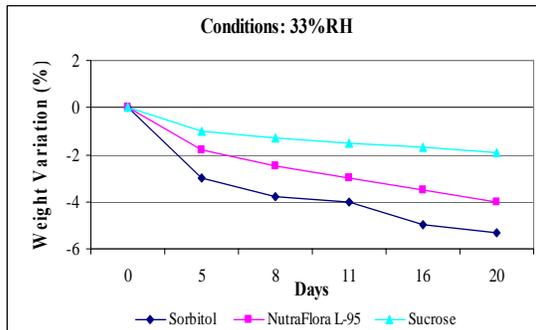
2.13 Moisture Absorption

NutraFlora is a hygroscopic ingredient that will absorb moisture over time, especially as relative humidity (RH) increases. Moisture gain observed for NutraFlora tends to be affected more by relative humidity than temperature. The graphs below compare the moisture binding ability of NutraFlora, in a powder form, to that of dextrose monohydrate.



Note: Additional moisture retention graphs for different temperature and relative humidity conditions are available upon request.

The graphs below compare the moisture absorption ability of NutraFlora to that of sucrose and sorbitol.



Flowability is maintained and moisture pick-up is prevented by limiting exposure to moisture and heat, handling in a climate controlled environment, adding flow agents and dry blending. The shelf-life of NutraFlora is indefinite for unopened packages stored under cool and dry conditions.

3. Applications

NutraFlora can be effectively added to a variety of applications (see Table 2) such as bakery products, bars, beverages and juices, candies and chocolates, meat analogues, sauces, dressings, and soups. In addition, NutraFlora can be included in dairy and frozen dairy products, desserts, dairy substitutes such as soy and rice products, and supplements.

Table 2. Application Information

Application	Flavor Improvement				Texture Improvement						Process Improvement				Other			
	Masking off-notes	Lower sweetener use levels	Synergy with high intensity sweeteners	Cooling effect control	Flavor enhancement	Mouthfeel improvement	Even crumb appearance	Binding improvement	Syneresis reduction	Improved stability	Conching at lower temperature	Faster rising dough	Baking and cooking time reduction*	Raises the freezing point	Shelf-life extension	Maillard browning control	Nutritional profile enhancement	Synergy with probiotics
Bakery ¹	•	•			•		•	•		•		•	•		•	•	•	
Bars ²	•	•	•	•	•			•		•					•	•	•	•
Beverages & Juices	•	•	•	•	•	•										•	•	
Dairy	•	•	•		•	•			•	•					•	•	•	•
Frozen Dairy	•	•	•		•	•			•	•			•	•	•	•	•	•
Confections	•	•	•	•	•			•			•		•			•	•	
Desserts	•	•	•	•	•	•		•	•	•			•	•	•	•	•	
Soy & Rice Products	•	•	•		•	•		•	•	•				•	•	•	•	•
Meat Analogues	•	•			•	•		•		•					•	•	•	
Soups, Sauces & Dressings	•	•			•	•			•	•					•	•	•	
Supplements	•	•						•								•	•	•

* Compared to sucrose

¹Coffee cakes, croissants, breakfast tarts, scones, sweet breads, sweet rolls, doughnuts, muffins, cookies, and crackers (including graham, saltine, and crisp-bread crackers)

²Energy, nutrition bars and high protein bars

4. Conclusion

The health and functional benefits of NutraFlora are summarized in Table 3.

Table 3. Summary of Benefits

Flavor Benefits	30% as sweet as sucrose Enhances fruit, dairy, vanilla, chocolate, and coffee flavors Masks off-notes associated with high intensity sweeteners and soy products Works synergistically with high intensity sweeteners, allowing for lower sweetener use levels
Texture Benefits	Improves moisture retention Adds humectancy and chewiness Reduces syneresis Extends shelf-life
Health Benefits	Gentle prebiotic fiber Improves digestive health Reinforces immunity Enhances mineral absorption
Additional Benefits	Low caloric content – 1.5 Kcal/g Does not participate in Maillard reaction Does not impact blood sugar levels or generate an insulenic response Non-cariogenic

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