



3. Solutions on Thaumatin Modification \*\*

Summary

Rank	Solution	Solution proposed by	Non caloric or very low caloric	Stable at low pH (~pH 3.0)	Sensory profile closer to sugar	No licorice taste or Aftertaste	Thermal stability	Stable to UV exposure	Low cost	Robust supply chain	Solubility
9	ThauMagic™ Thaumatin	EPC Natural Products Co. Ltd.	Zero caloric contribution	Stable at pH 3-7 and shelf-life stable	4,500 times sweeter than sugar	Clean taste, masks off notes, no bitterness or lingering aftertaste	Thermal (80C for 30 minutes) stable				Thaumatococcus is freely soluble in water



## Introduction

# Thaumatococcus (1/2)

- **Thaumatococcus is a single chain protein, 207 residues long.**
- Thaumatococcus (also known as talin) is a low-calorie sweetener and flavour modifier. The protein is often used primarily for its flavour-modifying properties and not exclusively as a sweetener. The thaumatococcos were first found as a mixture of proteins isolated from the katemfe fruit (Thaumatococcus daniellii Bennett) (marantaceae) of West Africa. Although very sweet, thaumatococcus's taste is markedly different from sugar's.
- The sweetness of thaumatococcus builds very slowly. Perception lasts a long time, leaving a liquorice-like aftertaste at high concentrations.
- Thaumatococcus is highly water soluble, stable to heating, and stable under acidic conditions.
- Thaumatococcus contains eight disulfide bonds and is thermally stable. However, once the molecule is denatured, it loses most or all of the sweet taste, presumably because it is difficult to refold them into the sweet, native conformation.
- Thaumatococcus is a non-nutritive protein substance isolated from fruit shrub **Thaumatococcus daniellii** growing in West Africa.
- Thaumatococcus is up to **3000x sweeter than saccharose**. **It is used to sweet frozen products, sweets, jams, chewing gums, soft drinks, yoghourts and other food.**
- **Thaumatococcus is acquired through water extraction (pH 2.5 to 4) of fruit ovaries.** It mainly contains proteins thaumatococcus I and thaumatococcus II, and a small amount of plant components coming from the original material.
- Thaumatococcus in fruit is generated in response to an attack upon the plant by viroid pathogens.
- Sweet taste of thaumatococcus markedly differs from the sweet taste of sugar - it develops very slowly but the sensation lasts long, and it recalls foul taste after licorice in high doses.
- Thaumatococcus is frequently used for its ability to modify (amplify) taste of other substances. Thaumatococcus is fully a natural substance, it metabolises as any other dietetic protein in the body.
- Due to high sweetening effect, it is used in small doses. Energy input from this quantity is negligible.
- **It is highly soluble in water, thermally stable even under acid conditions.**
- **Researchers achieved reductive methylation of Thaumatococcus by the procedure of Means and Feeney, without loss of sweetness intensity.**
- **Maltagen Forschung developed method for improving yield of thaumatococcus by using transgenic barley plant.** [Source](#)
- **As per [Natex UK Ltd.](#), Thaumatococcus is remarkably stable considering its proteinaceous nature. It is successfully applied in canning of pet food where it remains stable at temperatures of 120°C and in coatings subjected to dry temperatures of 140°C. Thaumatococcus is stable under pasteurisation and UHT conditions. Further enhancement of its physical and chemical stability can be achieved through reformulation with protective compounds. Its stability under acid conditions, to lower than pH 2, is a useful feature - a result of its molecular structure.**

[Source](#)

[Back to Contents](#)



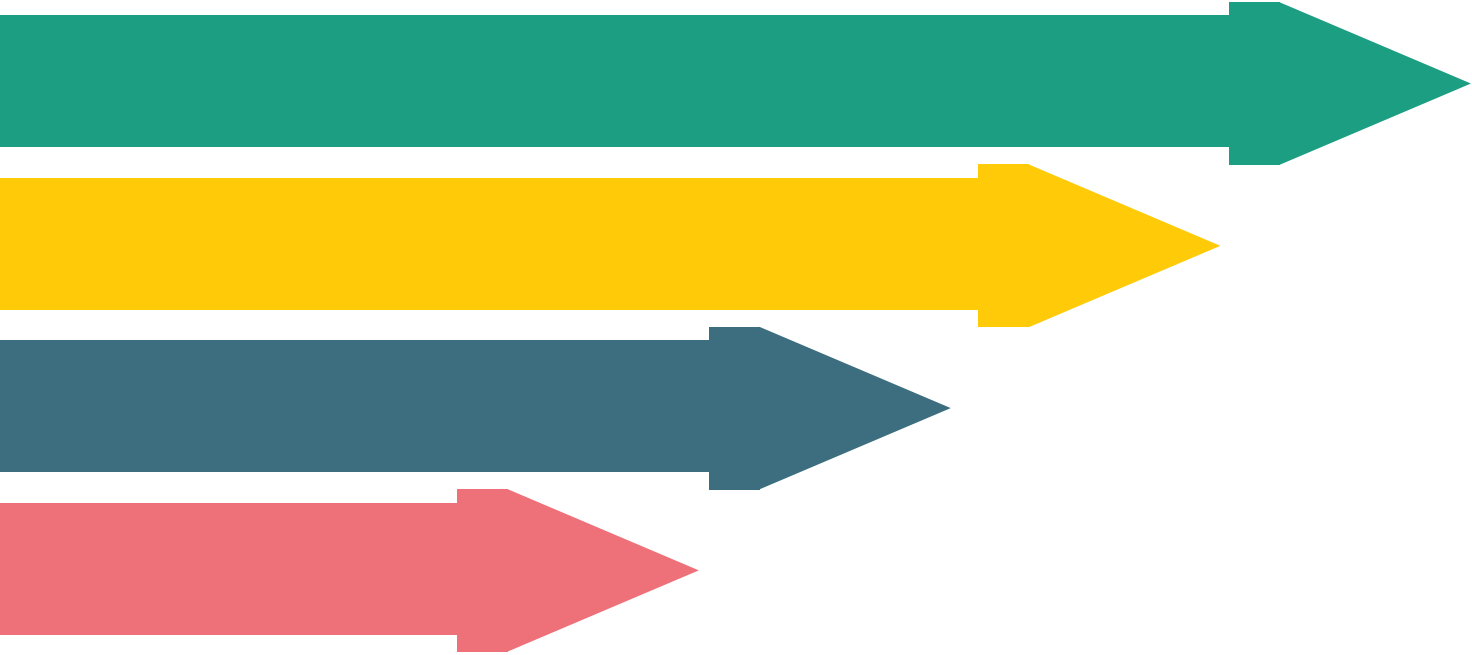
## Introduction

# Thaumatococcus (2/2)

- **Thaumatococcus** is a sweet-tasting protein isolated from the arils of *Thaumatococcus daniellii* Benth, a plant native to tropical West Africa.
- Naturally occurring thaumatococcus consists of six closely related proteins (I, II, III, a, b and c), all with a molecular mass of 22 kDa (207 amino acids).
- The protein have an isoelectric point of 12.
- The sweet taste of thaumatococci can be detected at threshold amounts 1600 times less than that of sucrose on a weight basis (equivalent to  $10^5$ -fold less on a molar basis); the threshold values are near  $10^{-4}\%$  or 48 nM, making these proteins the most intensely sweet substances known.
- The three-dimensional structure of thaumatococcus I has been determined at high resolution, revealing that the protein consists of three domains: (i) an 11 strand, flattened  $\beta$ -sandwich (1–53, 85–127 and 178–207, domain I); (ii) a small disulfide-rich region (54–84, domain III); and (iii) a large disulfide-rich region.
- A family of pathogenesis-related (PR) proteins has been referred to as thaumatococcus-like proteins, due to the remarkable homology between PR-5 proteins and thaumatococcus.
- Thaumatococcus is stable in aqueous solutions between pH 2.0 and 10 at room temperature. As occurs with aspartame it is nutritive, containing 4 kcal  $\text{g}^{-1}$ , but due to its intense sweetness, the amounts used are small enough for thaumatococcus to be considered and classified as a nonnutritive sweetener.
- Despite their structural relatedness to thaumatococcus, none of the PR-5 proteins has been reported to have a sweet taste.
- Despite extensive studies in this field, the structural basis of thaumatococcus's sweetness is still uncertain.
- There is no obvious structural similarity between the three-dimensional structures of thaumatococcus I and another sweet protein, monellin.
- Chemical modification studies have suggested that thaumatococcus's basicity is not the dominating factor in determining the intensity of its sweetness.
- A site-directed mutagenesis study has reported that mutation at Lys67, Lys137 or Tyr169 reduced sweetness by five-fold; the authors concluded that these residues contribute to determining sweet taste. Thus, the determinants of thaumatococcus's sweet taste remain controversial and obscure.
- Sequence analysis has revealed substantial homology between thaumatococcus and thaumatococcus-like proteins, but there are differences in some amino acid residues; in particular, there is a characteristic pattern of lysine residues in thaumatococcus, which suggests that some lysine residues may play an important role in sweetness.
- Van der Wel has suggested in his review that an increase in the basicity of thaumatococcus, by amidation of its carboxyl groups, can increase its sweetness.



[Back to Contents](#)



### 3.1 ThauMagic \*\*

[Back to Ranking](#)

## Solution

The solution to the problem is invented by EPC

**Application in  
food & beverages.**

- ❑ **EPC is the world's leading innovative company in identification, development and production of active natural ingredients.** Jingang Shi is The CEO of the company. More than 100 primary patents worldwide are part of the company. To be recognized as a premium producer of natural ingredients, EPC strictly and scientifically chooses and processes raw materials all derived from edible sources. **EPC is committed to provide natural solutions for people's healthier living in food & beverage, nutraceutical and cosmetic industry.** Company Headquarter regions is in Beijing, China. **Leading Edge Only (LEO) partners with EPC Natural Products Co. Ltd.** LEO was founded in 2009. LEO is developer of an online platform created to bridge the gap between innovators and corporates. The company's global innovation marketplace is a dynamic online platform to showcase the latest technologies and products to organizations seeking innovative services, enabling innovators to cost effectively showcase the latest technologies and products to a diverse array of corporations. Scott is the founder and CEO of LEO who oversees partnerships and creates valuable relationships. LEO launched the Global innovation platform in 2018 to give entrepreneurs, start-ups and small businesses a platform to be able to connect to corporates seeking the latest innovative solutions. LEO's mission is to find innovative solutions for their clients to help them solve their business challenges. Additionally, they aim to help innovators on their platform, by getting their voices heard in a crowded place.
- ❑ ThauMagic™ Thaumatin is a natural plant-based, high potency sweetener and referred to as the “6th Taste Ignitor”, a 100% Natural replacement for sugar and artificial sweeteners. **ThauMagic™ delivers an increase in full bodied sweetness, a clean quick onset and creamy mouthfeel, masks off notes, with no lingering aftertaste.** Successfully used in Low & No calorie beverages within the marketplace to replace sugar, ThauMagic™ Thaumatin also performs particularly well in dairy products, and is effective at as low as 1ppm due to Lipid and Thaumatin receptors being located in the same areas of the tongue, driving palatability. **It is 4,500 times sweeter than sugar with Zero calorie contribution. Thaumatin provides increased full bodied sweetness, quick onset, creamy mouthfeel, clean taste, masks off notes, and no bitterness or lingering aftertaste.** It is **Thermal (80C for 30 minutes), pH 3-7 and shelf-life stable.** Flavouring Enhancer/Sweetener E 957 (Regulation (EC) No 1333/2008) FEMA 3732.
- ❑ **It is 100% pure and natural, clean label, allergen free, Kosher and Halal Certifiable. Applications includes Beverages; Non-Alcoholic Drinks; Desserts; Sauces; Potato, Cereal, Flour and Starch Based Snacks; Cocoa and Chocolate Edible Ices; Chewing Gum; Confectionery; Flavoured Fermented Milk; Table Top Sweeteners; and Food Supplements.**
- ❑ Thaumatin is now being used in baked and savory foods, desserts, fruit juices, milk powder, soft drinks, chewing gums, and coffee products. **It is generally mixed with other natural sweeteners such as Stevia in order to reduce its bitterness. Available in the following forms - ThauMagic Thaumatin 93%; ThauMagic Thaumatin 45%; ThauMagic Thaumatin 10%; and ThauMagic Thaumatin 5% LIQ.**

[Source1](#) [Source2](#) [Source3](#) [Source4](#) [Source5](#) [Source6](#) [Source7](#) [Source8](#)

[Back to Contents](#)

### Solution

#### ThauMagic Thaumatin

- ❑ It is **5,000 times sweeter than sucrose at threshold concentrations and 2,000-3,000 times sweeter at the normal use levels of sucrose (6-10%)**. Thaumatin does not elevate blood glucose or affect body weight. **Mask off-flavor of high-intensity sweeteners.** Enhance flavor and improve balanced taste profile of the product (used below the threshold of sweetness). Lower the threshold of fat and salty taste perception, and effectively enhance the flavor of low-fat and salt-reduced products (Especially in low-fat dairy products, it can significantly enhance the creamy and fullbodied mouthfeel). **Overcome the off-notes experienced with functional ingredients (reduce the aftertaste and bitterness associated with vitamin C, the bitterness and astringency of vitamins B2 and B6, the bitter notes of caffeine, as well as the fishy flavor of protein and amino acids).** Thaumatin is ideal for use in acid conditions so that it is suitable for various typical acid soft drinks. It also can be pasteurized or even ultra-heat treatment sterilized.
- ❑ Thaumatin is freely soluble in water. Solutions of 10% can be obtained in 60% aqueous alcohol, and prehydration in a little water allows solubility in up to 90% glycol, monopropylene glycol, and sugar alcohols. **1** And then, liquid thaumatin can be mixed directly into essential oils or flavors without stratification.
- ❑ When 1 ppm thaumatin was added to the low-fat milk (with 0.5% fat content), the creamy mouthfeel increased by 40%. When 1 ppm thaumatin was added to the low-fat milk (with 1.05% fat content), the creamy mouthfeel increased by 67%. In defatted bactericidal lactobacillus beverage, the challenges are the unbalanced acid and sweet profile, the lack of fullness and creamy mouthfeel. After adding 1 ppm thaumatin, the overall fullness and creamy mouthfeel can be significantly improved with harmonized sweet/sour profile. This is a notable application in low fat dairy products which are normally sensed as being watery and lacking in body. When adding a small amount of thaumatin in the formulation, it can give a much greater sense of fullness.
- ❑ By adding thaumatin to the flavor system or fruit preparation that may be used to flavor a yoghurt for example can modify the perception of the creaminess and fat content of the product base and add an enhanced flavor effect. **Some of the thaumatin case studies includes sugar and gum confectionery; dairy-based ice cream and frozen yogurt; fruit/flavored still drinks; meal replacements and other protein drinks; vitamins and dietary supplements.**

## Solution

Classification	Food Names	Effect
Beverages	Fermented milk Refreshing drink with milk Lactobacillus drink	Alleviates the stimulant acidity and sour smell of lactic acid and acetic acid.
	Fancy drink-fruit milk (contained in a polyethylene bag)	Enhances milk taste and fruit flavor.
	Soybean milk drink	Removes the grassy smell and astringency of a soybean.
Confectionery and Bread	Japanese-style confections and cakes-Custard cream	Accentuates the flavor and taste of eggs, milk, oil, and fats, and improves flavor.
Dairy products, Desserts	Chilled custard pudding Custard pudding	Accentuates the flavor and taste of eggs, milk and improves flavor.
	Ice Cream A bar of sherbet	Accentuates the flavor and taste of milk and gives good body.
	Frozen Yogurt	Accentuates the aroma of flavors and gives refreshment.
	Cream for coffee	Enhances the aroma of coffee and the flavor of cream.





## ThauMagic (4/4)

### Applications

- ❑ Thaumatin has the potential to be used as flavoring substances in the production of food flavors. It can be regarded as the "unsung hero" in delivering the palatable taste of sugar-reduced or low-fat products.
- ❑ The late onset of sweetness and the ability of thaumatin to enhance flavors can be a useful benefit when working with both Pharmaceutical and Nutraceutical ingredients.
- ❑ Thaumatin is a multifunctional ingredient, and thaumatin synergies with stevia could present more opportunities in beverages, making it the 'natural' sweetener blend equivalent to the successful Ace-K and aspartame blend.

### Conventional Solutions

Conventional Thaumatin had lingering aftertastes.

Earlier, the protein sweetener was not thermally-stable for enough time.

### Advantages

ThauMagic™ delivers an increase in full bodied sweetness, a clean quick onset and creamy mouthfeel, masks off notes, with no lingering aftertaste.

Thaumatin is Thermal (80C for 30 minutes), pH 3-7 and shelf-life stable.

### Comments

- ❑ Thaumagic Thaumatin is a Natural Sugar Reduction Solution that retain full sugar taste, have natural aroma profile with reduced cost, enhances full-bodied mouthfeel, clean label and shorten R&D cycle.