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Thaumatococcus daniellii comes from the berry of the plant *Thaumatococcus daniellii*.

Among sweeteners, sweet proteins have high sweetness potency compared to sugar and decompose into a normal distribution of amino acids on hydrolysis. To date, thaumatin is the only commercially available natural sweet protein.

This versatile ingredient has a wide range of applications in foods, drinks and pharmaceuticals, particularly in the field of taste modification.

Overview

Investigation into the isolation and use of taste modifying polypeptides has been largely driven by their high sweetness potency. Natural proteins identified as sweet include miraculin from the "Miracle Fruit" *Synsepalum Dulcificum*, monelin from the "Serendipity Berry" *Dioscoreophyllum Cuminsii* and thaumatin from the "Katemfe Fruit" *Thaumatococcus Daniellii*. Of these only thaumatin is commercially available at scale.

The product has a particularly powerful effect on taste; it has the ability to enhance elements of the flavour and sweetener compounds and simultaneously to mask other elements. Thaumatin's dramatic effects have their source, as do other flavour enhancers, in the structure and nature of the molecule and the way in which it interacts with both taste receptors and flavour molecules.

History

W F Daniell, in the *Pharmaceutical Journal*, first documented the existence in Africa of the fruit from which thaumatin is extracted in 1855 in which he referred to it by its local name 'Katemfe' and described it as 'The Miraculous Fruit of Soudan'. He reported considerable trade in the bright red triangular fruit and its use as a powerful sweetener and flavour enhancer in local foods and drinks¹.

Thaumatococcus is the sweetest substance known to man at approximately 2,500 times sweeter than sugar. Historically this has distracted attention from its more important properties of thaumatin's taste modification and flavour enhancement.

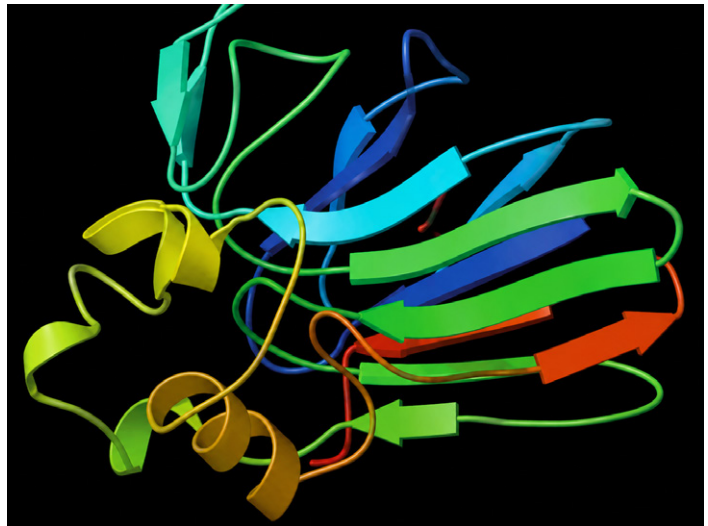


Structure and Nature

Thaumatococcus, extracted unmodified from the Katemfe fruit using purely physical extraction methods consists of very closely related Thaumatococcus proteins. These have a single polypeptide chain or 207 “normal” amino acid residues linked with 8 disulphide bridges giving a molecular weight of around 22,000 Da.

Thaumatococcus is completely digested by man and animal, which together with its “normal” amino acid sequence, accounts for its acceptance by regulatory authorities around the world as a safe, natural substance².

Thaumatococcus has the normal calorific value of a protein (4.1 Kcal/g) but in use is essentially non-calorific due to the very low levels required (parts per million). It is very basic with an iso-electric point of around 11.5 and freely soluble in water.



Thaumatococcus Molecule



Pure Thaumatin flakes

Stability

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 compounds³. Its stability under acid conditions, to lower than pH 2, is a useful feature - a result of its molecular structure.

Taste Mechanism

Thaumatococcus has a demonstrable effect on various groups of taste receptors, in various species of animal, for which it is used in feeding stuffs, as well as in man and is assumed to operate with the majority of taste receptors. This feature is a result of its particular structure. In the analogy, often used, of flavour molecules being “keys” and the taste receptors being “locks”, thaumatococcus appears to act as a “master key” in its action with all taste receptors.

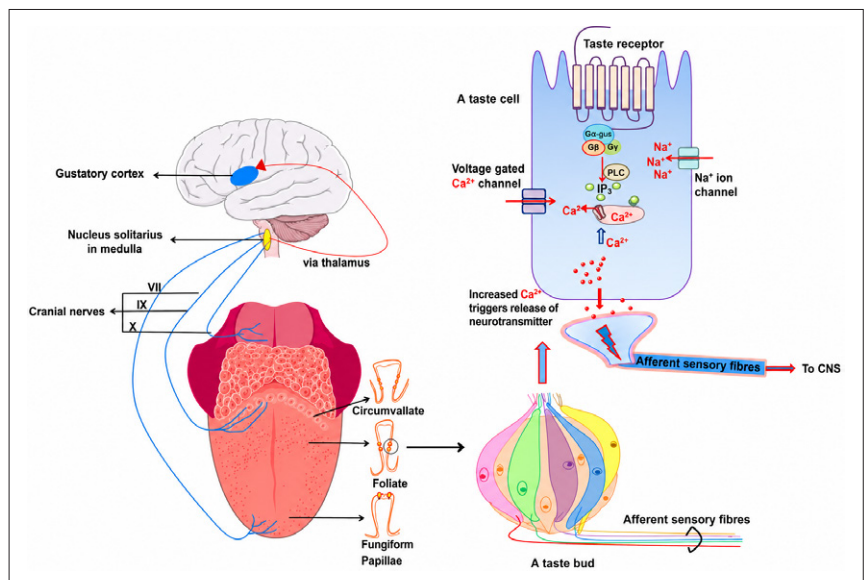
Thaumatococcus's effect in operating with all the taste receptors is the major reason for its wide range of applicability in situations requiring flavour modifications.

The electrical charge distribution on the thaumatococcus molecule is believed to be a major factor in the mechanism of interaction with both the taste receptor and the flavour molecules. This is demonstrated by the specific masking effects on the typically bitter unpleasant taste of metallic ions such as sodium, iron, potassium and its simultaneous enhancement of other free ions, e.g. chloride.

Its effect with more complex sweeteners and flavour compounds support the view that thaumatococcus's mechanism operates according to the relative nature of the individual molecules present. This is particularly evident in its effect with sweeteners such as stevia and saccharin and flavours such as peppermint, ginger, cinnamon and coffee, which it enhances while simultaneously reducing the fiery, peppery or bitter elements associated with them.

Thaumatococcus's high and rapid solubility in water and its tendency to increase salivation are additional physical features that increase the effect of flavours and aromas, particularly where physical contact with the taste receptors is limited.

The strength of the interaction between the thaumatococcus molecule and the taste receptors is believed to account not only for its potency but also for its effects in prolonging the effects of flavours and sweeteners.





Properties And Application

Thaumatins properties can be usefully summarised under the headings of:

- Enhancing
- Synergism
- Blocking

Its applications are, however, less easy to categorise in the same way because its properties can act simultaneously and in many product applications are utilised together.

Enhancing

Thaumatins is effective in enhancing a wide range of flavour compounds, including savoury flavours and, in particular “dominant” flavours such as ginger or menthol. Due to its ability to reduce the aggressive nature of these complex flavour compounds, thaumatins provides the opportunity to achieve higher levels of flavour in products without these being too aggressive and for instance, in coffee flavoured products, without generating bitter notes⁴.

A clear synergism is shown when using thaumatins in conjunction with intensity sweeteners and with flavour enhancing compounds MSG and 5’ nucleotides. With aspartame for example, a commercial application showed sufficient synergy between thaumatins and aspartame that a thaumatins inclusion of 10 parts per million could reduce the aspartame by more than 30% to achieve the original sweetness level⁵. In addition to the synergistic effects thaumatins improved the sweetness profiles of non-nutritive sweeteners giving “body” to the sweeteners and blocking the associated aftertaste as well as extending the sweetness and flavour profiles.

In savoury products enhancement is more complex. In addition to enhancement of flavours directly, thaumatins synergises with naturally present or added flavour enhancers such as 5’ nucleotides and monosodium glutamate (MSG). This adds a unique element of what the Japanese industry describes as “Umami” or, approximately translated into English, “deliciousness”.

Synergism

Thaumatins is often considered the most potent form of natural sweetness available. While it has some application as a standalone sweetener, due to its liquorice aftertaste and taste blocking function at high use levels, these applications are limited. In combination with other natural sweeteners such as Stevia and Monkfruit, Thaumatins can function as a sweetness enhancer and remove unwanted aftertastes of the other sweeteners. The sweetness enhancing ability also shows in conjunction with low intensity sweeteners, raising the sweetness potency of the combination to a higher level than the individual sweeteners show on their own. The structural and chemical properties of Thaumatins make it most effective when processed together with these other sweeteners before use in application rather than being added as a separate compound.

Applications in conjunction with natural low intensity, non-nutritive sweeteners are of interest in products requiring an “all natural” or clean label. Thaumatins application in products in conjunction with added MSG and nucleotide compounds, or where nucleotides are naturally present, for instance in pet food, exhibit a high degree of synergy with these compounds

The additional masking effects of metallic flavours provide a range of applications in low sodium products where NaCl has been replaced in part with KCl.

These key functions that allow for sugar, sweetener and salt reduction help supporting the demand for healthier foods and meeting new requirements from recent changes in regulations.

Blocking

Thaumatins masking effects, particularly of metallic or bitter tastes, are an important feature accounting for its widespread use in the human and animal food industry and with high intensity sweeteners and in particular with saccharin.

Thaumatins is particularly effective in masking the metallic aftertaste of saccharin, with this combination being used in a wide variety of products from tabletop sweeteners to animal feeds. In citrus fruit products, thaumatins has been shown to be very effective in masking the bitter elements of natural flavours from the fruit hence its application in products such as juices, yoghurts and desserts.

A good example of thaumatins simultaneous action is to be found in applications with vitamin C, often flavoured with citrus and sweetened with high intensity sweeteners. In this application thaumatins also masks the bitter notes and the sweetener aftertaste, enhances the flavour and contributes to the sweetening. At high levels of inclusion but still in parts per million ranges, thaumatins is effective in masking the taste of some pharmaceutical products in chewables and suspensions.



Safety and Regulation

Of the natural sweet proteins, thaumatin is the only one that is widely accepted as safe by regulatory authorities. As a result of its background as a high intensity sweetener, thaumatin has been subjected to the intense scrutiny of regulatory authorities and WHO, typical of a high intensity sweetener. Thaumatin is widely approved and has been positively reviewed by the JECFA with a full toxicological and safety data package. In 2026 a review of the thaumatin monograph was undertaken at the 100th JECFA meeting with no changes suggested by the committee members.

Thaumatin has GRAS status by FEMA and FDA as a flavour in the USA, is an approved sweetener and flavour enhancer as laid down in the European Regulation on Food Additives EC 1333/2008 and is approved as a natural food in Japan. Under the International Codex Standard 192, thaumatin is approved for general use in foods worldwide without restriction.



Future Potential

When thaumatin was first commercialised in the 1980s, its intense sweetness defined its regulatory approval and commercial positioning. However, despite being an intensely sweet natural protein, its exceptional potency prevents its use as a standalone sweetener. Instead, it works synergistically with other sweeteners to enhance sweetness and flavour while blocking the bitter aftertaste of sweeteners such as stevia.

As global pressure to reduce sugar intensifies, the need for ingredients that deliver healthier products without compromising taste has never been greater. With its natural origin, clean-label appeal, and unique flavour-modifying properties, thaumatin is becoming an essential ingredient for the next generation of food and beverage innovation.



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