



TREND DEEP DIVE

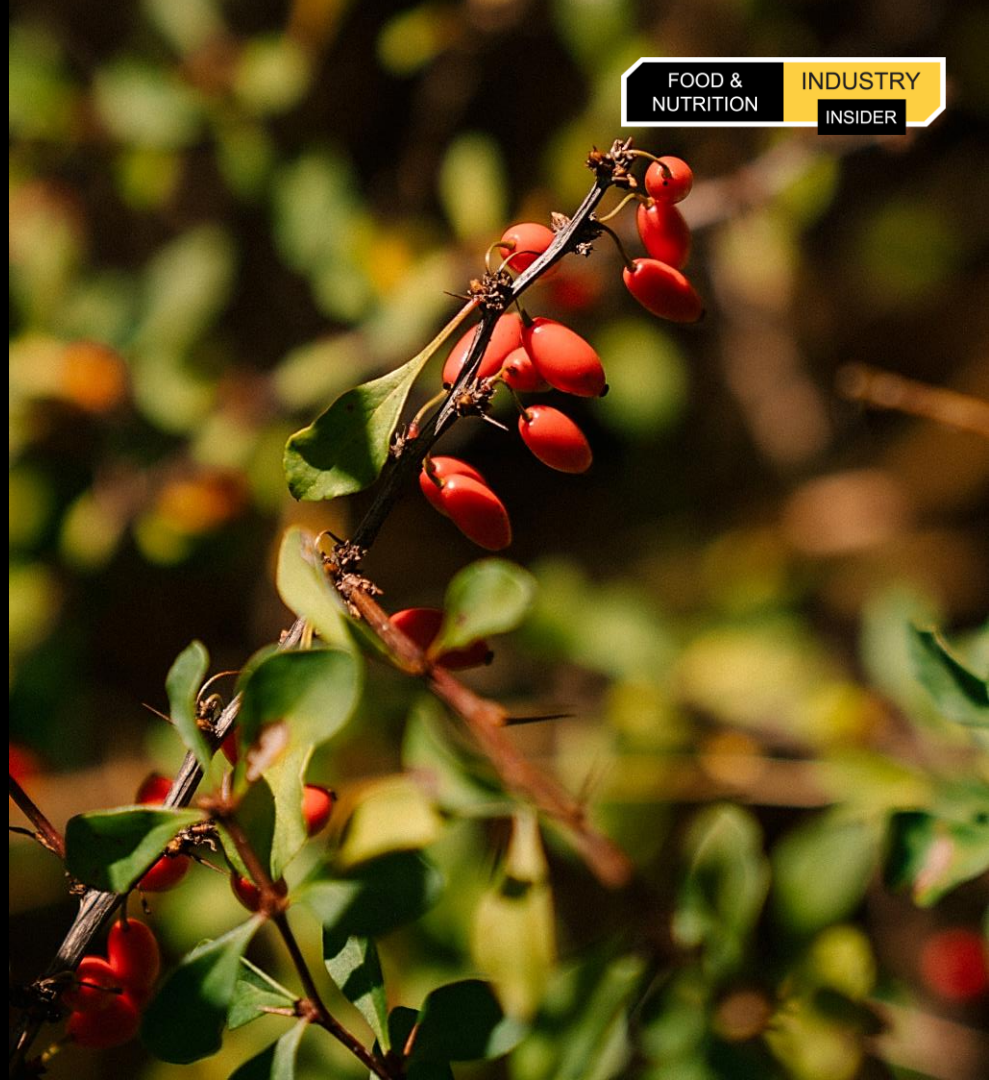
Sweet Proteins

2H 2020

FutureBridge

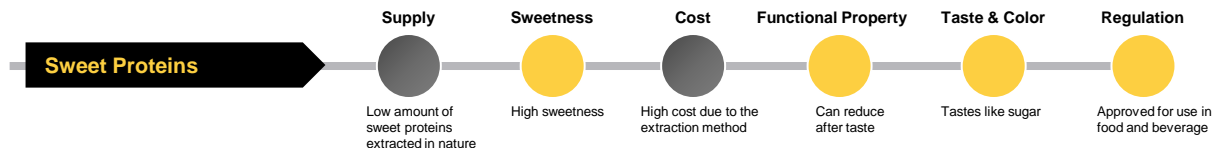
FOOD &
NUTRITION

INDUSTRY
INSIDER



Sweet Proteins – Technology Introduction

Sweet proteins bind to taste receptors and elicit or enhances the sweetness of products



KEY PARAMETERS FOR MARKET ADOPTION

● High ● Moderate ● Low

PATENTS

- Patents in the **sweet protein segment** have been observed to be focusing on **reducing challenges** such as **high cost of extraction** and **higher yield**
- Sweet proteins** are being utilized in **blend format** to **reduce the bitter after taste** of **high-intensity sweeteners** and ingredients such as **glycine**

SWEET PROTEINS CONSIDERED

Brazzein	Monelin	Neoculin	Miraculin
Thaumatococin	Mabinlin	Curculin	Pentadin

Sweet Proteins

PROS

- Sweet proteins** can reduce the **after taste** of ingredients such as **glycine**
- Sweet protein provides **higher sweetness** with **lower calories**
- Utilizing sweet proteins enables companies to have **healthier label-claim** as they are **digested as proteins** and **not carbohydrates**

RESEARCH & REGULATION

- The **research** segment is focused on **increasing the yield of sweet protein** by **genetic modification of microbes** and **plants**
- The genetically modified microbial technology **increases yield** and **reduces the cost of production**. GMO plants may have **higher regulatory restrictions** and may not be suitable due to higher

MARKET ADOPTION

- Sweet protein **thaumatococin** is the major **commercialized** protein due to **regulatory approvals** and **no adverse health effects**
- The sweet protein **launches** have steadily **increased** with a **CAGR of 7.7%** from **2015-2019**
- The **high cost of extraction** is a significant challenge for **commercialization**

CONS

- High production cost** due to the **extraction process**

Illustrative Player Ecosystem

Start-ups and established ingredient players are producing sweet proteins

Ami Proteins

Joywell

TALIN
A Naturex Product

TATE & LYLE

iSweetch!

ALKION
BIO INNOVATIONS

MiraBurst
Taste the Sweet Sensation

MAGELLAN
LIFE SCIENCES

Cweet

INGREDIENT MANUFACTURER

KEY

Startup

Small-medium company

Established company

Sweet Proteins – Product Formulation Snapshot (Jan 2015 to Nov 2020)

Sweet protein thaumatin is the major commercialized protein due to regulatory approvals and no adverse health effects

Product Formulation Snapshot (Global, Jan 2015 – Nov 2020)

Categories of product launches from 2015 to 2020(YTD)



Category-wise product distribution

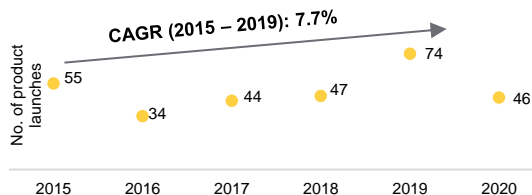
Top 3 companies



Top 3 countries



Product launches (Jan 2015 – Nov 2020)



Source: Commercial product database and FutureBridge analysis

Key: ↑ Growth from 2015 to 2020; YTD: Year to date

FutureBridge Viewpoint

- The **sweet protein** use has been increasing in the **meal replacement segment**
- The sweet protein **thaumatin** is the **most studied** and **commercialized** protein
- The sweet proteins launches have **steadily increased** with a **CAGR of 7.7%** from 2015-2019
- Thaumatin has high launches in **Brazil, Japan, and Australia** due to **regulatory approvals**
- The **high cost of extraction** is a significant challenge for commercialization

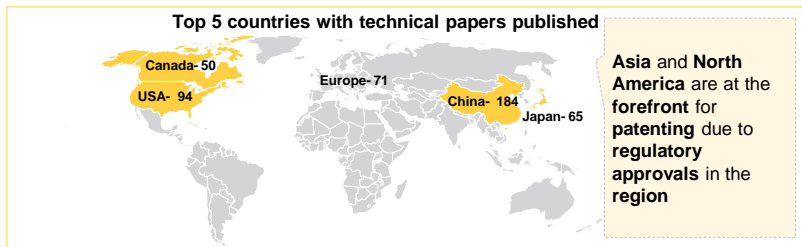
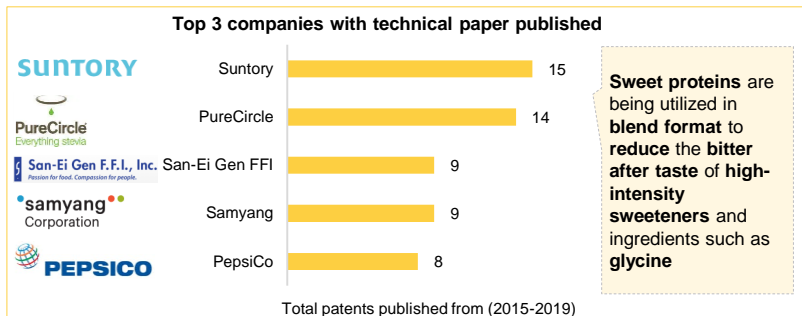
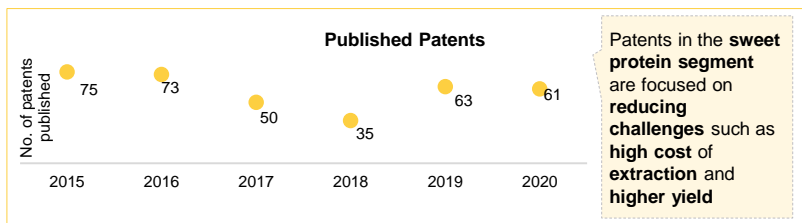
Illustrative Player Ecosystem



Note: Representative player ecosystem. Does not include all players

Sweet Proteins – Patent Analysis (Jan 2015 to Nov 2020)

Patents in the sweet protein segment are focused on reducing challenges such as increasing yield and lowering the cost of production



Insider Pick – Provides a method to improve the taste of glycine utilizing thaumatin



Patent: [JP2020014458A](#)

Title: Taste improver for glycine

Assignee: San-Ei Gen FFI

Inventors: Hasegawa Jun, Kondo Akane et.al.

Claim: The patent describes a method to **improve the taste** of the **glycine-containing product**. The taste improver contains **Momordicae grosvenori extract** and **thaumatin**. The ingredient contains 0.00625 parts by mass of mogroside V and at least 0.00025 parts by mass of thaumatin. The thaumatin content can improve bitter taste.

Insider Pick – Provides a method to extract thaumatin with lower extraction cost



Patent: [CN111574607A](#)

Title: Method for extracting thaumatin from African arrowroot based on microbial fermentation

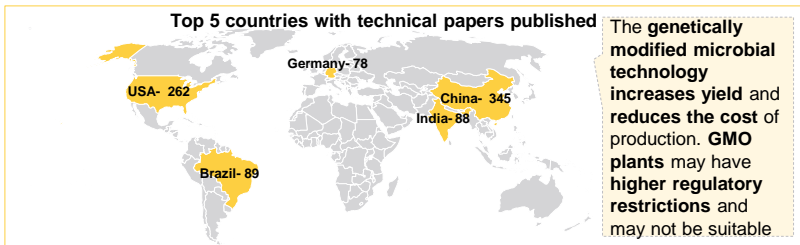
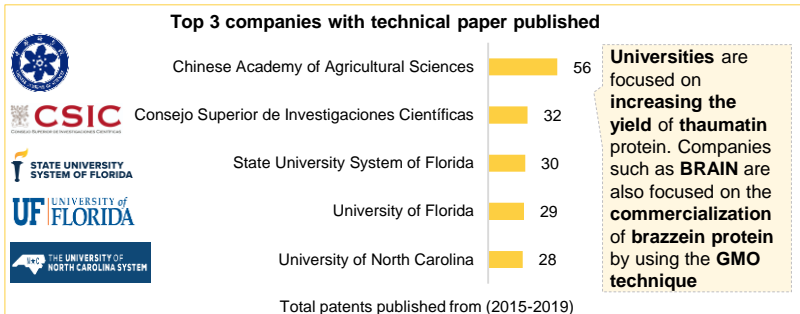
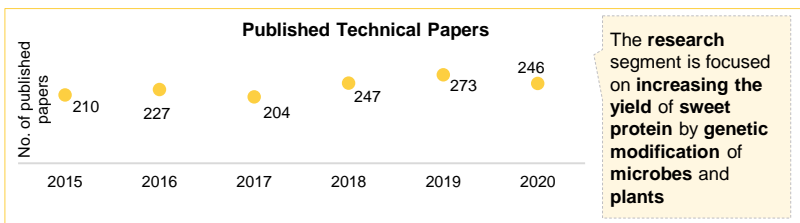
Assignee: WuHan HuaSweet

Inventors: Chen Pengfei, Hu Siqian et.al.

Claim: The patent describes a method to **extract thaumatin** from **African arrowroot** by **microbial fermentation technology**. Arrowroot fruits contain **thaumatin crosslinked with cellulose**. The **cellulose** can be **degraded** using **cellulase** and **amylase enzymes** from **microbes**. The **yield** of thaumatin is increased by **22-31%**. The method can **reduce the extraction cost** and **reduces loss** of seed and kernel, which is present in traditional method.

Sweet Proteins – Technical Paper Analysis (Jan 2015 to Nov 2020)

Research in the sweet protein segment is focused on utilizing genetic modification and fermentation technology



Insider Pick – Utilizing genetic modification to produce sweeter brazzein protein



Title: [Removal of the N-terminal methionine improves the sweetness of the recombinant expressed sweet-tasting protein brazzein and its mutants in Escherichia coli](#)

Researchers: Bo Liu, Hua Jiang, et.al.

Key takeaways

- Overexpression of **brazzein protein** in a heterogeneous host – **E.coli** is an essential way for its mass production in the food industry
- The **recombinant protein** in the absence of the **N-terminal methionine** displayed a sweetness threshold of about **1.5 µg/ml**, which is the **sweetest brazzein protein** reported

Insider Pick – Utilizing genetic modification to produce mass-produce thaumatin protein



Title: [Expression of thaumatin, a new type of alternative sweetener in rice](#)

Researchers: Shahina Akter, Md. Amdadul Huq, et.al.

Key takeaways:

- **Thaumatin gene** was introduced in **duel cauliflower mosaic virus 35S promoter** into **rice (Oryza sativa L. var. Japonica cv. 'Dongjinbyeo')** by **Agrobacterium-mediated transformation** to produces **transgenic plants**
- Expression of **thaumatin gene** in **transgenic rice** resulted in the accumulation of **thaumatin protein** in the **leaves** and is also **present in T1 generation** of the plant

Source: Commercial research database & FutureBridge analysis | Search string: Brazzein OR Thaumatin OR Monelin OR Curculin OR Mabinlin OR Miraculin OR Pentadin OR sweet protein

Sweet Proteins – Recent Development Trends (2018 to 2020)

Companies are partnering, investing, and researching, which is focused on the commercialization of sweet proteins such as thaumatin, miraculin, and brazzein



Partnership

- Ocean Spray partners with Amai Proteins to create protein-sweetened cranberry juice. Under the partnership, Ocean Spray and Amai Proteins plan to develop the product with at least a 40% sugar reduction.



Investment

- Joywell Foods (previously known as Miraculex) received USD 6.9 Mn in a Series A round. The funding was led by Evolv Ventures, which is backed by Kraft Heinz. Other investors include previous seed-round investors such as Khosla Ventures, SOSV, Alumni Ventures Group, and other investors.



Research

- BRAIN's initiative PepDancer Project is working on taste modulation of Brazzein protein after a single amino acid substitution
- Amai Proteins have developed a novel computerized 'designer' sweet protein. The product is developed using Computational Product Design (AI-CPD) that designs sweet proteins with 70-100% similarity to sweet proteins

FutureBridge Viewpoint

- **Amai Proteins** is highly active with its **designer sweet proteins** that are produced via **fermentation**. Amai Proteins **partnership** with **Ocean Spray** is expected to **increase** its **market presence**
- The **Joywell Foods investment** is expected to aid in the **commercialization** of **miraculin sweet protein**. **BRAIN's project** is expected to help in the **commercialization** of **brazzein protein**
- The **high cost of extraction** of sweet protein has allowed its use in **smaller quantities in blend format**. The industry is currently focused on **reducing the challenges** by using **genetic modification** and **fermentation technology**

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