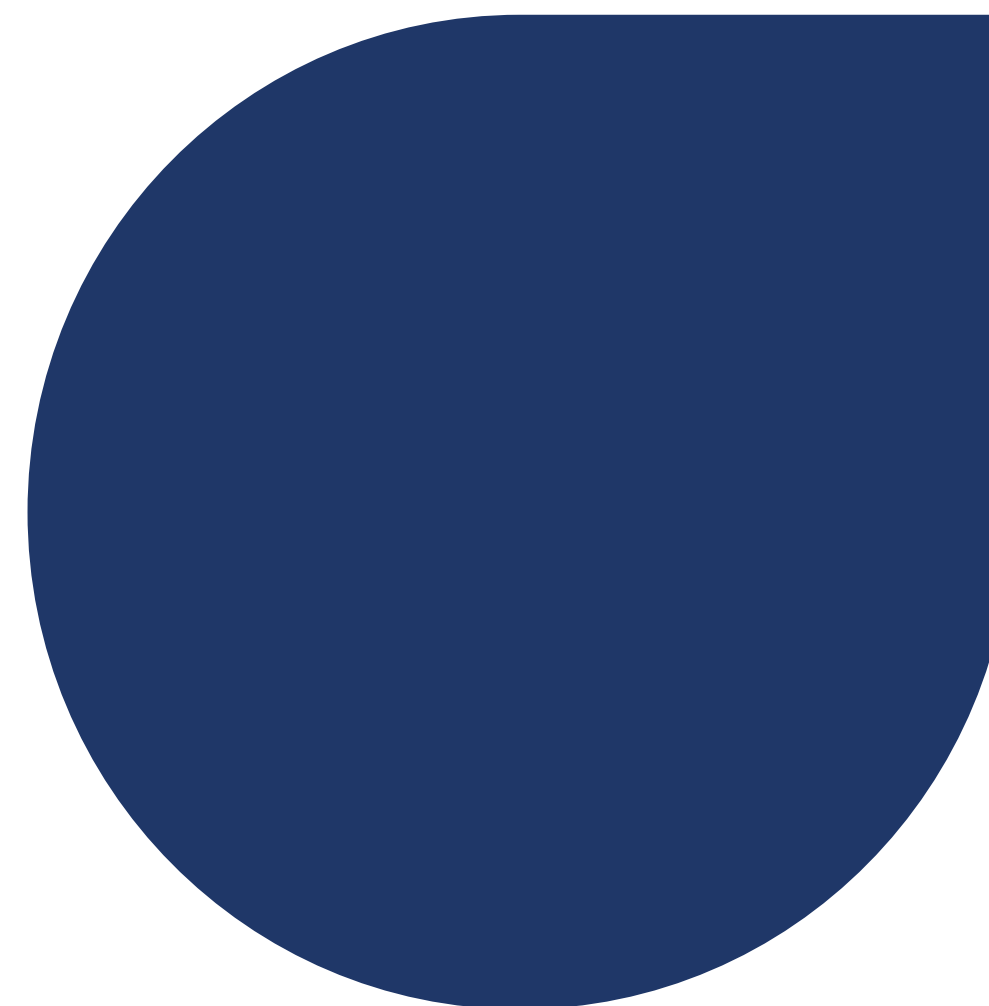


Understanding the Market Dynamics and Formulation Challenges of Healthy Gummies

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Market Dynamics

Trends in the Sugar Confectionery Market

There are three key trends that have emerged in the global sugar confectionery market.

Sugar Reduction

Consumers are concerned for their health, and manufacturers are under pressure to reduce the sugar content of their products.

Sugar reduction remains one of the biggest challenges and biggest opportunities for gummies.

Vegan Options

Launch activity in vegan sugar confectionery continues to grow in key markets in line with consumers' ethical concerns.

Gen Z in particular are interested in these products. However, many consumers remain unconvinced of the benefits of vegan gummies.

Fortification

Fortified gummies have become increasingly common in the Vitamins & Supplement space because they're convenient and tasty.

Leading markets show there is significant growth to come in this space.

Sugar Reduction

While consumers show strong interest in sugar reduction NPD in the sugar confectionery space, such products continue to play a limited role in the market. This is because of the technical hurdles involved in delivering a compelling experience.

– Richard Caines, Senior Food & Drink Analyst, Mintel (June, 2022)

Sugar Reduction

In the UK, 67% of sugar confectionery buyers would be interested in reduced sugar, low sugar or sugar-free sweets that are free from artificial sweeteners.

→ This drops to just 1/3 of people who would try a new reduced sugar sweet regardless of artificial sweeteners.



Low/Reduced Sugar claims in Pastilles, Gums, Jellies and Chews have grown by

250%

Q1 2023 v Q1 2022

Mintel GNPD (USA, Canada, Japan, Australia, New Zealand, South Korea, UK, Germany)

These claims are clearly on the rise, with low/reduced sugar claims being more popular than sugar-free claims. Research also shows that of people reducing their candy consumption, 48% attributed this to focusing on reducing their sugar intake.

However, consumers are in general more willing to support their health by reducing their intake of regular products rather than trading them in for reduced sugar alternatives.

We need to offer something beyond just low or reduced sugar!

Vegan Options

Vegan/No Animal Ingredient gummy launches have increased by

202.4%

since 2018

– Mintel GNPD: Pastilles, Gums, Jellies and Chews, Region (USA, Canada, Japan, AU, NZ, South Korea, UK, Germany).

Vegan Options

We've seen many mainstream brands create vegan alternatives to standard gummies in the past few years. Plant-based diets are trending across most markets, with general interest high.

- However, according to research conducted by Mintel in 2022, only 12% of UK consumers are currently interested in sweets that use only vegan ingredients.
- Vegan sugar confectionery will become more common over the coming years, but less headline worthy as flexitarian eating becomes more the norm. The growth of this space will be challenged by the fact that not many consumers have 'vegan' at the top of their "must have" list.
- Making the benefits of plant-based options clearer is critical to gaining mass traction.
- As well as this, early research suggests that plant-based claims in sweet snacks and treats may appeal to health-conscious parents.



Fortification

“Fortified gummies have become increasingly common because they are convenient, tasty and have fewer medical associations than pills.”

– Mintel, Trend Observation ‘Faster Gummies’ (April, 2023)

Fortified Gummies

Looking at the USA, Canada, Australia, NZ, the UK and Germany since 2018, only 2.2% of gummies were functional or had 'plus' claims. This rises to a whopping 23% of South Korean and Japanese gummy launches over the same time period.

We know that these two countries often lead health and wellness trends, so these statistics suggest that there is a lot of growth still to come in the fortified gummy space.

The most common functional claims being made in gummies over the last 5 years were:

- Energy
- Beauty Benefits
- **Stress & Sleep**
- Digestive
- **Prebiotic**
- Skin, Hair & Nails

According to consumer data from 2022, between 34-41% of consumers who use vitamins and supplements would be interested in a gummy format.



Market Examples

1



Kabaya Foods, Energy Drink Flavour Energy Zone Gummy.

Described as hard and springy and coated with sour powder with added caffeine. Contains L-arginine. Claims to aid concentration.

Japan, 2022.

2



Organica, Shine Muscat Flavour Sugar Free Gummy with Vitamins B & C.

Vegan gummies with 12mg of Vitamin B1 and 1000mg of Vitamin C per 30g serve.

South Korea, 2022.

3



Project 7, Sour Gummy Worms.

Described as plant-based and keto-friendly gummies that have 86% less sugar than regular gummies. Said to be a good source of fibre and contain no artificial sweeteners, flavours, or colours.

USA, 2022.

Formulations & Challenges

Standard Gummies

Total solid range: 75 - 85

pH range: 3.8-4.2

Aw: <0.77- 0.79

Relative sweetness (Rel S): 50-60

Depositing: thin hot viscosity needed.

Shelf Life: stable at ambient temperatures.

Texture: gelatine or starch/ gelatine combination in local market.

Recipe: the trick of a good gummy is to have a balance of all below specifications.



Standard Gummy Formulation	
Ingredients	%
42 DE glucose Syrup	33-35%
Sugar	33-35%
Starch	8-10%
Citric Acid 50% solution	To suit
Gelatine 220B 20M	4.0-6.0%
Water	To balance
Total	100%

Textural Attribute	Description	Hedonic score (1-5)
Hardness	Strength of bite, firmness, fracture	4 to 5 is ideal
Gumminess	Stickiness, cohesive, tooth pull	3-4 is ideal
Springiness	Elastic, “memory”	3-4 is ideal

Enhancements on a Standard Gummy

Based on trends above, then 3 enhancement avenues are possible:

- Vegan;
- Low or reduced sugar;
- Fortification;
- Or a combination of the above.

Creating vegan gummies means replacing the gelatine with another gelling hydrocolloid. Examples include:

- Pectin, Starch, Agar and Carrageenan and Gellan gum (LA and HA combo).
- Each has its foibles and retrofitting to existing equipment can be complex.

In all cases compliance with the regulatory universe is required and not always simple. Food? Country?



Enhancements continued...

Sugar Reduction

- The definition of sugars must be adhered to, as well as the definitions of what constitutes Free, Low and Reduced sugar.
- All depends on the regulatory authority one is under.

Fortified

- Regulatory authority is everything here (TGA or FSANZ for Australia).
- Fortified and low sugar are expected. The 2 areas possible under FSANZ are:
 - Formulated Supplementary Foods; criteria for protein level to be met.
 - Formulated Supplementary Sports foods; very prescriptive on type, amount and form of mineral fortification possible. E.g. Magnesium amino acid chelate not allowed.
- The solubility of minerals is important, as is addition order → we need to consider the free ions.
- Fortificants that are oil soluble or do not affect gelling process are easier to handle in the formulation. E.g. Vitamin C or fish oil.

Technical Challenges - Introduction

Given complexities and broad scope of possible formulations we focused our R&D work on 2 systems:

- 99% sugar free and vegan. ...targeting good hedonic scores.
- 99% sugar free and fortified. ... targeting a workable system.
- **Sugar:** is a sweetener, but also plays an important role in the hydrocolloids gelling mechanism; texture and mouthfeel; Aw and stability of gummies. All this must be balanced when sugar is replaced.
- **Sugar Replacers:** several factors to consider in addition to organoleptics → solubility; molecular weight (control of Aw) and relative sweetness (Rel S).
- **Shelf-life:** FSANZ standards require that sugar-free gummies have a similar shelf-life to traditional gummies, and thus, proper formulation and storage conditions need to be implemented.
- **Processing:** Correct processing method needs to be determined based on the formulation, type of hydrocolloid used, type of sugar alternatives (order of addition and solubility). Scale up will be more challenging compared to standard gummies.

Technical Challenges - Texture and Consistency

Some issues and solutions for low, reduced and no sugar recipes.

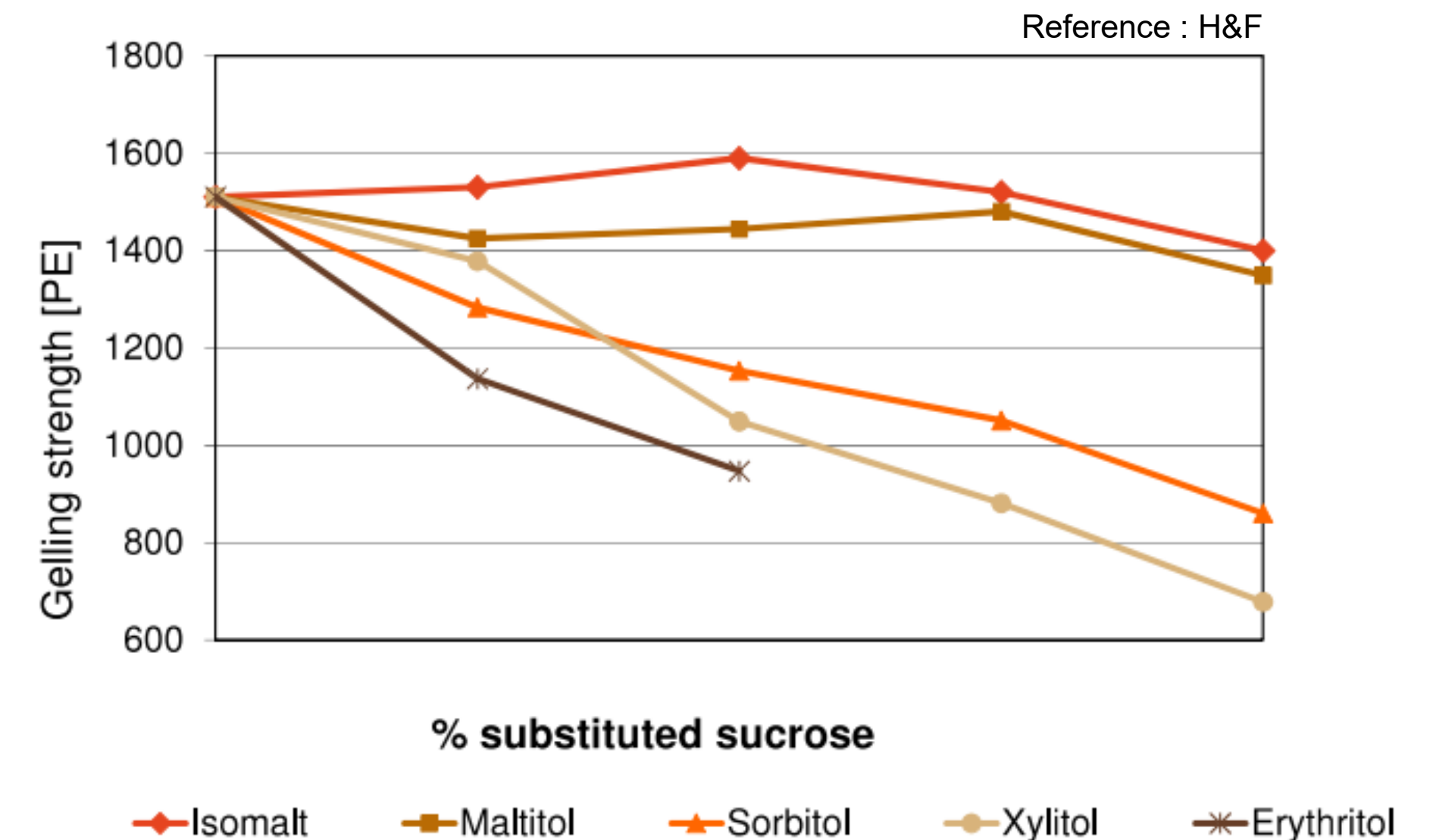
Defect	Possible causes	Trouble shooting
Pre-gelation and crumbly texture when using pectin	Depositing temperature too low	Increasing pH, reducing total solids and increasing depositing temp
Crystallization	Very high total solids Use of low soluble polyols	Reduce total solids Increase syrup, reduce crystalline powders
Weak gel (hardness < 3)	High or incorrect pH (pectin) Too low brix (pectin) Low gum concentration Type of gum Gums not hydrated properly	Adjust acid amount to reach pH range of pectin being used Total solids > 70 Improve hydration process Increase gum concentration
Syneresis	Low gum concentration Too high gum concentration Aw control Low total solids Too high sugar syrups	Adjust formulation according to the defects cause



Technical Challenges - Sugar Replacement

Sugar Alcohols/Polyols: organic compounds, typically derived from sugars. Often used in combination with high intensity sweeteners to enable formulators to achieve a higher sweetness level while complying with Maximum Permitted Levels. Usage levels can be limited due to potential laxative effective associated consumption.

Sugar Alcohol	Relative Sweetness	Properties
Erythritol	60-80%	Non-caloric bulk sweetener, fermentation process, can be considered natural.
Maltitol	75-90%	Replacement for both sucrose and glucose syrup phases. Sweetness and functionality similar to sucrose.
Sorbitol	60%	Replacement for both sucrose and glucose syrup phases. Less potential laxative effect than maltitol.
Xylitol	95-100%	Solubility close to sucrose. Helps with Aw due to low MW.
Isomalt	45-60%	Enhance flavour release and imparts firmness.



The dosages of the sugar alcohols should be formulated in a way to maximize their gelling strength. E.g. erythritol used < 7% due to low solubility, which causes re-crystallization and crumbly texture over shelf life.

Technical Challenges - Sugar Replacement

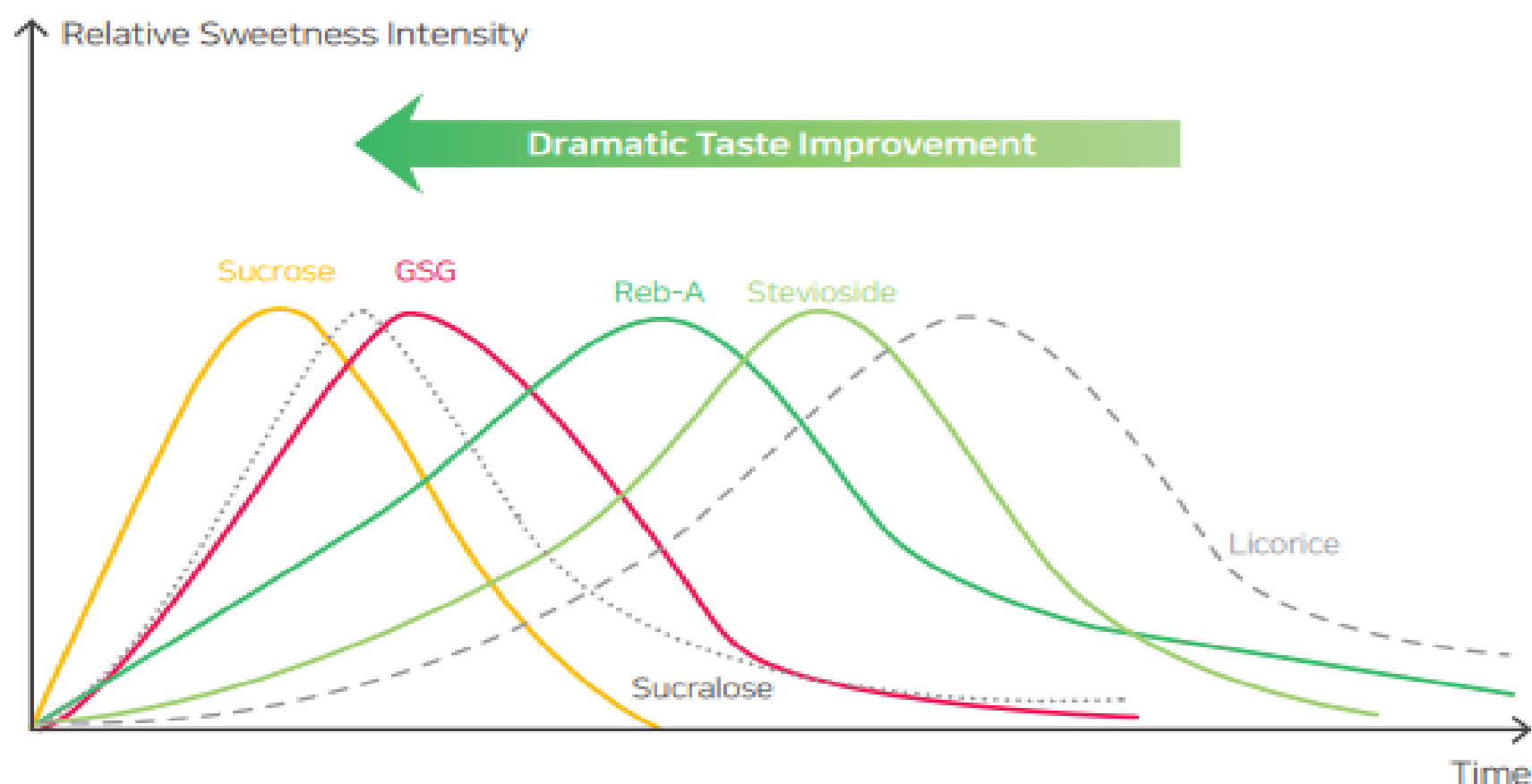
Non-digestible Oligo or Polysaccharides: These products are lower in calories than sugar, have soluble dietary fibre and often pre-biotic properties. Large polysaccharides (MW>5000) tend to be unsuitable as sugar replacer because of their low solubility and high viscosity. These compounds can be used to replace the crystalline phase of the sugar and thus decrease the polyol % required. Unlike sugar alcohols there are no laxative effect concerns.

A consideration when formulating is that although they have good solubility, overdosing them can result in cloudy gummies. Moreover, since they are high molecular weight compounds, the water activity (Aw) is negatively affected by them, hence need to be balanced with low MW polyols to achieve the desired Aw.

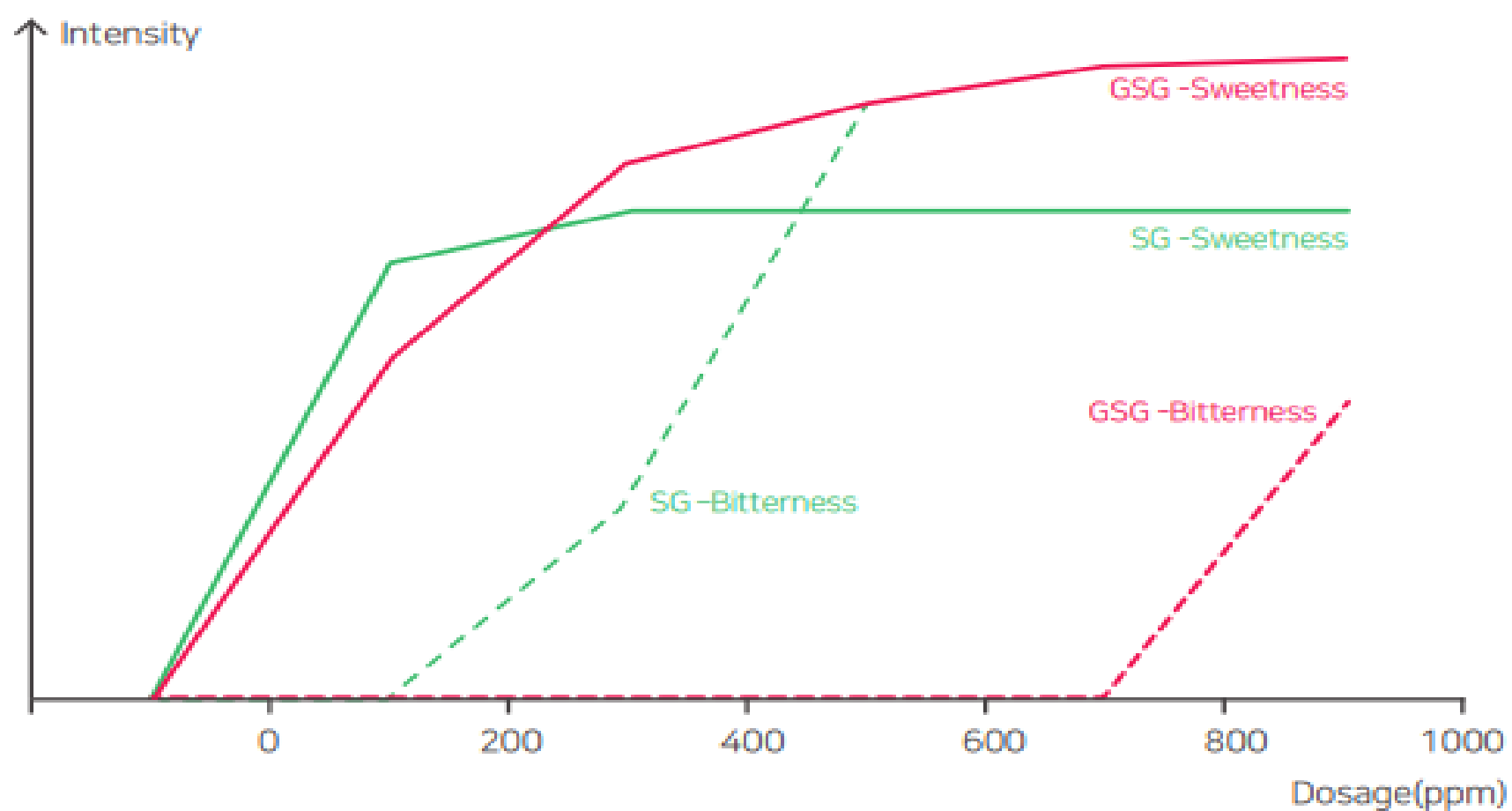
Bulking Agents	Properties
Polydextrose	Highest solubility amongst all replacers, improves crystallization, no laxative effect concerns.
Dextrin	Soluble, delivers good body to the gummies, no laxative effect concerns.
Soluble Corn Fibre	High solubility, gives improved mouthfeel.
FOS, Inulin	Textural benefits – mouthfeel. FOS has higher solubility than inulin.
Gum Acacia	Thickener, stabilizer, high water solubility – some sweetness.

Several of these bulking agents can also be used to increase the fibre content of gummies. Again, it's important to check for regulatory compliance before claims can be made in this regard.

Technical Challenges - Sugar Replacement



Sweetness Curve over Time



Reference : Daepyoung

Non-nutritive sweeteners:

- These are high intensity sweeteners that are non-caloric and 200-13,000 times sweeter than sugar, making them suitable for use at very low concentrations.
- Some examples include Aspartame, Saccharin/cyclamate and Sucralose.
- However, most of these sweeteners are artificial and hence have limited attractiveness given the positioning of healthy gummies being sought after.

Non-nutritive natural sweeteners:

- The most common is the Stevia family of steviol glycosides. Thaumatin and Monk fruit (mogrosides) also have regulatory approval for use in some jurisdictions.
- Several other extracts show potential but have limited or no regulatory approval.
- Most high potency sweeteners have varying degrees of delay in flavour impact and bitter/off notes associated with them. There is no “1 stop solution”.
- Selection of relevant steviol glycosides and new glucosylated steviol glycosides (GSG) helps minimise the flavour delay and bitterness/off notes.

Technical Challenges – Shelf Life & Processing Issues

Shelf Life

Below are some examples of how to make shelf life stable gummies.

- **Hardening/Softening** – manage A_w , once product is packaged water migration can occur between different components. Also, hydrocolloids continue to hydrate/ rearrange over time...kinetics vs thermodynamic considerations at play here.
- **Microbial Spoilage** – follow pH and A_w tables for different formulations. GMP at processing stage, starchless moulds.
- **Syneresis** – one of the most common issues is incorrect/uncontrolled water activity (too low or too high).

Processing

Some considerations:

- Starchless moulds are quite often needed, and different set up is required.
- Gums hydration: order of addition, hydration time and temperature.
- Citric acid & fortificants should be added towards the end of the processing (after cooking off to required brix). The addition needs to be slow to avoid pre-gelling of gums.
- Dry ingredients should be added slowly.



Typical Formulations to Meet Market Requirements

Ingredients	99% Sugar-Free, Vegan & Fortified	99% Sugar-Free & Vegan
Pectin Classic AS519	3.0	-
StabiL CF 735	-	4.0
Magnesium Phosphate	1.0	-
Sorbitol Syrup	35	35
Xylitol Powder	17	17
Soluble Corn Fibre	15	15
Dextrin	15	15
Citric Acid Solution	4	3
Flavour	0.4	0.4
Colour	0.2	0.2
Stevia	0.07	0.07
Water	To balance	To balance
Total	100	100

	99% Sugar Free, Vegan & Fortified	99% Sugar free & Vegan
pH	3.2-3.3	3.4-3.5
Aw	0.79	0.79
TSS (%)	78-80	78-80
Hardness	4	4
Gumminess	1	4
Springiness	1	3

Result: two recipes that attempt to meet the standard confectionary gummy textural and physical property attributes.

- The sugar free, vegan and fortified gummy struggles on 'gumminess' and 'springiness'. The sugar free and vegan is closer to a standard gummy.
- Aw, Rel S and TSS% have been met and will result in stable product that should be acceptable organoleptically.
- The claims and labelling attached to these recipes will depend on the aspect of FSANZ being targeted. Formulated supplementary sports food requires 10% of RDI for example.

Conclusion: *"Many ways to the top of the mountain."*

Thank You!

Visit our exhibitor table to
try our two healthier
gummy concepts!

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