

Report

Cryobites

A Note-by-Note Approach to Edible Non-Melting Ice Cubes (A Food for the Future Concept)

Advanced Molecular Gastronomy TFCS9025: 2024-25

Submitted by

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1. Introduction

The evolution of modern cuisine has increasingly employed scientific understanding to transform not only how food is prepared, but also how it is perceived. One of the most significant movements in this transformation is **molecular gastronomy**, a scientific discipline that explores phenomena occurring, such as physical and chemical mechanisms involved during cooking (Burke, This and Kelly, 2016). It focuses on enhancing controlled precision in food preparation, introducing techniques such as **sous vide** (precise low-temperature cooking in vacuum-sealed bags), **foaming** (the creation of stable gas-liquid dispersions), and **gelling** (using hydrocolloids like agar, carrageenan, or gellan gum to produce desirable texture) (Barham et al., 2010). Rooted in chemistry and physics, molecular gastronomy has led to new culinary techniques and concepts, encouraging chefs to go beyond traditional ingredients and embrace scientific tools and compounds in food preparation. (Caporaso, 2021).

A more recent and specialised growth of this movement is **note-by-note cooking**, introduced by Hervé This in 1994 in his article published in *The American* (This, 2013). Unlike molecular gastronomy, which still relies on whole ingredients, note-by-note cooking uses **pure compounds**. This method allows precise control over taste, texture, colour, and nutrition. He proposed the use of pure compounds to enhance dishes and products (This, 2013). Herve regarded this method of cooking to be much like how composers would write melodies, note-by-note (This 2014). This new concept has continued to grow since, from being served by chefs at the Cordon Bleu, to being applied to university curricula in both food science and culinary programs. This innovation led to an international competition that continues to this day (Burke, R. et.al., 2016).

Within this framework, this report introduces **CryoBites**, an edible, non-melting, ice-like product developed using note-by-note cooking. CryoBites aim to simulate the refreshing, melting sensation of ice-cubes while remaining structurally stable at room temperature. The product utilises a gellan gum matrix activated through controlled heating, combined with polyols and menthol to induce a **cooling, water-like mouthfeel** (Europa.eu, 2019). CryoBites are designed to be portable, shelf-stable, and sustainable, making them ideal for space missions, desert environments, and emergency conditions, where conventional refrigeration is unavailable. The development of CryoBites exemplifies how note-by-note cooking can address the **global challenge of future food innovation** by offering functional, efficient, and sustainable alternatives (This, 2014).

2. Aim

This project aimed to design and develop “**CryoBites**,” a scientifically formulated, edible, non-melting ice-like product created using note-by-note cooking techniques. The goal was to

simulate the sensory experience of melting ice while ensuring shelf stability, portability, and regulatory compliance. CryoBites were conceptualised as a forward-thinking solution to future food challenges, particularly for use in space travel, desert environments, and emergency conditions where conventional refrigeration is not feasible.

3. Materials and Methods

2.1 Materials

The ingredients and equipment used in the preparation of the cryobites are listed in the tables below.

For the Inner flavoured core of cryobites

Table 1: *Ingredients used in each recipe presented below*

Ingredients	Quantity	Specification	picture
Water(Filtered)	200ml	Foruisce True water	
Xylitol	25g	Xylitol(E967) Sosa	
Matcha Powder	3g	Sosa code 41460	
Menthol	2g	N/A	N/A
Stevia	2g	E 960	N/A
Gellan gum F	2g	E 418 MSK-1181 Batch: 54713	
Blueberry freeze-dried powder	3g	MSK-0774 Batch-52852	
Raspberry oil-soluble flavour	5ml	MSK-1442/44869	

For the Outer Transparent outer layer

Table 2

Ingredients	Quantity	brand	picture
Water(Filtered)	150ml	Foruisce True water	
Xylitol	25g	Xylitol(E967)	
Gellan gum F	3g	E 418 MSK-1181 Batch: 54713	
Glycerol	3g	E 422	N/A
Menthol	1g	N/A	N/A

For Plating

Table 3

Ingredients	Quantity	Specification	Picture
Concentrated gel food colouring Black	1g	Colour Splash Classic	
Coconut Powder	1g	Sosa	
Blueberry Freeze-Dried powder	1g	MSK-0774	

Equipment

Table 4: Equipment used in the preparation of each recipe presented below

Equipment	Specification	Picture
-----------	---------------	---------

Weighing Balance	CAMRY	
Stove	Gas Stove	
Saucepan		
Whisk	Steel	
Bowl	Steel	
Temperature Probe	TP101	
Silicon ice cube moulds	Silicon	
Refrigerator	b Broadericks 44230 (precision -18)	
Plate	Used for plating	
Brush	Wood brush for coloring	

2.2 Methods

The CryoBites were developed using a Note-by-Note culinary approach, incorporating pure compounds instead of traditional food ingredients. The methodology was divided into two key phases: formulation of the flavoured inner core and creating a transparent outer layer.

2.2.1 Flavoured Inner Core

To develop the flavoured inner layer of cryobites, all the ingredients were weighed using a weighing balance. 200 ml of water was heated up to 90 °C. Once the desired temperature was reached, xylitol, Stevia and 3g of gellan gum F(Low acyl) were slowly added while continuously whisking to avoid clumping. Menthol was then added, and the mixture was stirred continuously for 2 minutes until fully dissolved. When the mixture had developed, it was removed from the heat and divided into two bowls. In one bowl, 3g of matcha powder was added and thoroughly mixed. In the other bowl, 3g of Blueberry freeze-dried powder and 5 ml of Raspberry flavour were added and mixed properly. Both mixtures were then cooled slightly before pouring into moulds.

2.2.2 Preparation of Outer Transparent Layer

To prepare the outer transparent layer, 150 ml of water was heated to 90 °C. Once the desired temperature is reached, Xylitol, stevia and gellan gum F were slowly added while continuously whisking to prevent clumping and bubbling. Glycerol was then added to retain moisture in the final product. The mixture was stirred for 2 minutes until fully dissolved. After preparation, the solution was removed from the heat and cooled slightly before pouring into moulds.

2.2.3 Preparation of fully transparent cryobites

In parallel, a batch of fully transparent CryoBites was prepared using the same outer gel matrix, but without incorporating any inner core. These cubes were designed to resemble frozen, crystal-like structures, intentionally minimal in flavour and colour to enhance the visual illusion of floating ice cubes. This version served as a contrast to the dual-layered CryoBites and allowed visual balance during final plating.

2.2.4 Assemble the CryoBites

To assemble the cryobites into their proper shape, matcha and berry mixtures were poured into small cubic-shaped silicone moulds. They were placed in a fridge for 10 minutes. Once they had developed into their proper shape, they were unmolded and transferred to another large cubic silicon mould. A thin layer of transparent non-flavoured solution was poured and allowed to rest for 5 minutes. Then, the already developed matcha and berry inner core were added. Another layer of transparent solution was added on top. After resting for a while at room temperature, the cryobites were placed in a fridge for 15 minutes to observe their final structure and texture.

2.2.4 Final Plating and galaxy design

For the final presentation, a matte black colour was done using the brush on a round white plate to enhance the contrast of the dish components. A galaxy style was created using a variety of edible powders to mimic a cosmic spiral. Coconut powder, and freeze-dried berry powder, were distributed in a spiral formation using fine sieves and pastry brushes, creating a layered, radiant galaxy design.

CryoBites were arranged centrally, alternating between transparent and dual-layered versions. This multisensory approach was intended to simulate an interstellar experience while reflecting the possibilities of note-by-note innovation for the future of food.

4. Results

The experimental preparation successfully produced two primary types of CryoBites: (1) dual-layered cubes containing a flavoured inner core and a transparent outer shell, and (2) fully transparent gel cubes without any inner filling.

4.1 Flavoured Inner Layer

The inner core of the CryoBites set successfully with a firm yet delicate texture. It retained a clear, well-defined shape after demolding, showing no signs of collapse or deformation. Despite its firmness, the core released a notable watery sensation during tasting, giving the illusion of a melting ice cube. The use of matcha and berry flavours gave the cubes a soft green and pink colouration, both of which remained intact during the moulding process without colour bleeding. The low-acyl gellan gum effectively stabilised the gel.

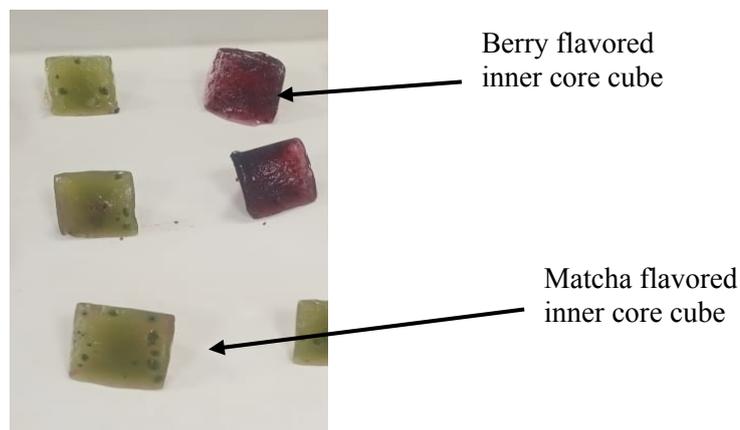


Figure 1: Matcha and berry flavoured inner core obtained through gelation with gellan gum.

4.2 Outer Transparent Layer (Shell)

The outer transparent layer, designed to resemble an icy, glistening surface, was made using a slightly higher concentration of low-acyl gellan gum. It successfully encapsulated the inner core in some CryoBites, forming a water-clear, firm shell. However, some cubes were made entirely from this transparent mixture without a core, which mimicked an icy structure more effectively but lacked flavour. These transparent cubes were aesthetically pleasing and held their shape well, even after demolding.



Figure 3: Matcha and berry flavoured cryobites

4.3 Sensory Analysis

A sensory evaluation test was conducted, where 12 participants assessed the sensory performance of cryobites. Two different hedonic scales were employed: a 3-point scale for visual and sweetness attributes, and a 5-point scale for more complex sensory parameters like texture, mouthfeel, and cooling sensation. The responses were compiled, averaged, and represented in tabular form and a radar chart for clear interpretation. The following are the results of the sensory evaluation:

Attributes	Scale Point	Results Graph	Graphs								
Colour & Clarity of Outer Transparent Layer	1. Not Clear at all 2. Somewhat clear 3. Very Clear	7/12- Somewhat Clear 4/12- Very clear 3/12- Not clear at all	<p>Rate the color and clarity of outer transparent layer</p> <table border="1"> <caption>Data for Rate the color and clarity of outer transparent layer</caption> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Not clear at all</td> <td>1</td> </tr> <tr> <td>Somewhat clear</td> <td>7</td> </tr> <tr> <td>Very clear</td> <td>4</td> </tr> </tbody> </table>	Category	Count	Not clear at all	1	Somewhat clear	7	Very clear	4
Category	Count										
Not clear at all	1										
Somewhat clear	7										
Very clear	4										
Uniformity of Colored spheres inside	1. Not Clear at all 2. Somewhat Clear 3. Very Clear	8/12- Somewhat Clear 4/12- Not clear at all	<p>How would you rate the uniformity of the colored inside spheres?</p> <table border="1"> <caption>Data for How would you rate the uniformity of the colored inside spheres?</caption> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Not clear at all</td> <td>0</td> </tr> <tr> <td>Somewhat clear</td> <td>8</td> </tr> <tr> <td>Very clear</td> <td>4</td> </tr> </tbody> </table>	Category	Count	Not clear at all	0	Somewhat clear	8	Very clear	4
Category	Count										
Not clear at all	0										
Somewhat clear	8										
Very clear	4										
Sweetness of Cryobites	1. Not Sweet at all 2. Somewhat sweet 3. Very Sweet	6/12- Neutral 4/12- Very Sweet 2/12- Not Sweet at all	<p>How would you rate the sweetness of cryobite?</p> <table border="1"> <caption>Data for How would you rate the sweetness of cryobite?</caption> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Not sweet at all</td> <td>2</td> </tr> <tr> <td>Somewhat sweet</td> <td>4</td> </tr> <tr> <td>Neutral</td> <td>6</td> </tr> </tbody> </table>	Category	Count	Not sweet at all	2	Somewhat sweet	4	Neutral	6
Category	Count										
Not sweet at all	2										
Somewhat sweet	4										
Neutral	6										

Table 5: 3-Point scale sensory result

Table 5 represents the 3-point hedonic scale to evaluate outer clarity, inner uniformity, and sweetness. The highest score was obtained for outer clarity, with most participants rating it as "somewhat clear" or "very clear," indicating that the outer layer of CryoBites was visually appealing. Sweetness was rated positively by the majority, reflecting a generally pleasing

flavour. Inner uniformity received a relatively lower score, with responses indicating inconsistent distribution of the internal colored spheres

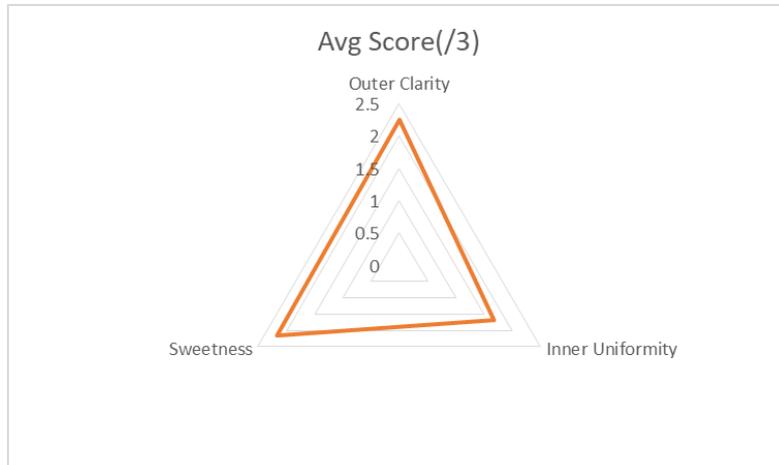


Figure 4: 3-Point scale sensory result radar chart

The 3-point scale radar chart (Figure 4) was constructed to visually represent participant responses across three core attributes: clarity of the outer transparent layer, uniformity of the colored element inside, and sweetness of the CryoBites. Each axis of the chart corresponds to one attribute, with a score range from 1 (lowest) to 3 (highest), based on average participant ratings.

The chart reveals a clear visual trend:

- Outer clarity reached the furthest point on the chart with an average score of 2.25, indicating a strong perception of clarity and visual appeal.
- Sweetness also extended outward, averaging 2.17, suggesting general satisfaction with the sweetness intensity.
- In contrast, inner uniformity showed the shortest extension from the centre, scoring 1.67, which reflects a less consistent visual distribution of internal elements.

Attributes	Scale Point	Results	Graphs
Texture	1. Very Soft 2. Somewhat Soft 3. Neutral 4. Somewhat firm 5. Very firm	6/12- Neutral 4/12-Somewhat firm 1/12-Somewhat soft 1/12-Very Soft	How would you rate the texture of cryobites?

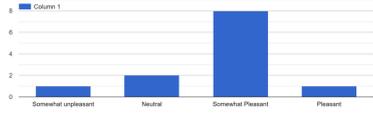
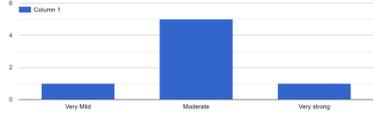
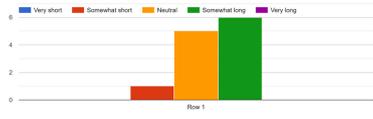
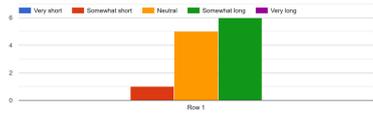
Mouthfeel	<ol style="list-style-type: none"> 1. Unpleasant 2. Somewhat unpleasant 3. Neutral 4. Somewhat pleasant 5. Very Pleasant 	<p>8/12-Somewhat pleasant 2/12-Neutral 1/12-Somewhat Pleasant 1/12- Pleasant</p>	<p>How would you rate the mouthfeel of the cryobite?</p>  <table border="1"> <caption>Mouthfeel Rating Data</caption> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Somewhat unpleasant</td> <td>1</td> </tr> <tr> <td>Neutral</td> <td>2</td> </tr> <tr> <td>Somewhat Pleasant</td> <td>8</td> </tr> <tr> <td>Pleasant</td> <td>1</td> </tr> </tbody> </table>	Rating	Count	Somewhat unpleasant	1	Neutral	2	Somewhat Pleasant	8	Pleasant	1
Rating	Count												
Somewhat unpleasant	1												
Neutral	2												
Somewhat Pleasant	8												
Pleasant	1												
Intensity of Cooling Sensation	<ol style="list-style-type: none"> 1. Extremely Mild 2. Very Mild 3. Moderate 4. Very Strong 5. Extremely Strong 	<p>5/12- Moderate 1/12-Very Mild 1/12-Very Strong</p>	<p>How would you rate the intensity of cooling sensation in the cryobite?</p>  <table border="1"> <caption>Cooling Sensation Intensity Data</caption> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Very Mild</td> <td>1</td> </tr> <tr> <td>Moderate</td> <td>5</td> </tr> <tr> <td>Very strong</td> <td>1</td> </tr> </tbody> </table>	Rating	Count	Very Mild	1	Moderate	5	Very strong	1		
Rating	Count												
Very Mild	1												
Moderate	5												
Very strong	1												
Duration of cooling sensation	<ol style="list-style-type: none"> 1. Very short 2. Somewhat short 3. Neutral 4. Somewhat long 5. Very Long 	<p>6/12- Somewhat Long 5/12-Neutral 1/12-Somewhat short</p>	<p>How would you rate the duration of the cooling sensation in the cryobite?</p>  <table border="1"> <caption>Cooling Sensation Duration Data</caption> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Somewhat short</td> <td>1</td> </tr> <tr> <td>Neutral</td> <td>5</td> </tr> <tr> <td>Somewhat long</td> <td>6</td> </tr> </tbody> </table>	Rating	Count	Somewhat short	1	Neutral	5	Somewhat long	6		
Rating	Count												
Somewhat short	1												
Neutral	5												
Somewhat long	6												
Water- Like Sensation in the mouth	<ol style="list-style-type: none"> 1. Yes, it felt just like melting ice. 2. Yes, but it was more like a soft gel turning into liquid. 3. Somewhat, but not exactly like water 4. No, it felt more like jelly or a solid texture. 5. Not at all 	<p>6/12- Yes, it felt just like melting ice 4/12-Somewhat, but not exactly like water. 2/12-yes, but it was more like a soft gel turning into liquid.</p>	<p>How would you rate the duration of the cooling sensation in the cryobite?</p>  <table border="1"> <caption>Cooling Sensation Duration Data</caption> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Somewhat short</td> <td>1</td> </tr> <tr> <td>Neutral</td> <td>5</td> </tr> <tr> <td>Somewhat long</td> <td>6</td> </tr> </tbody> </table>	Rating	Count	Somewhat short	1	Neutral	5	Somewhat long	6		
Rating	Count												
Somewhat short	1												
Neutral	5												
Somewhat long	6												

Table 6: 5-Point scale sensory result

Table 5 represents the 5-point hedonic scale to evaluate more complex attributes of cryobites, including texture, mouthfeel, cooling sensation, and water-like melting effect. For texture, most responses were between “neutral” and “somewhat firm,” suggesting the CryoBites were neither too soft nor too rigid. Mouthfeel was positively received, with the majority describing it as “somewhat pleasant” or “very pleasant.” The cooling sensation was mostly rated as “moderate” in intensity and “somewhat long” in duration. For the water-like sensation, most participants reported it was somewhat similar to melting ice, but not entirely. Only a few described the texture as gel-like or solid.

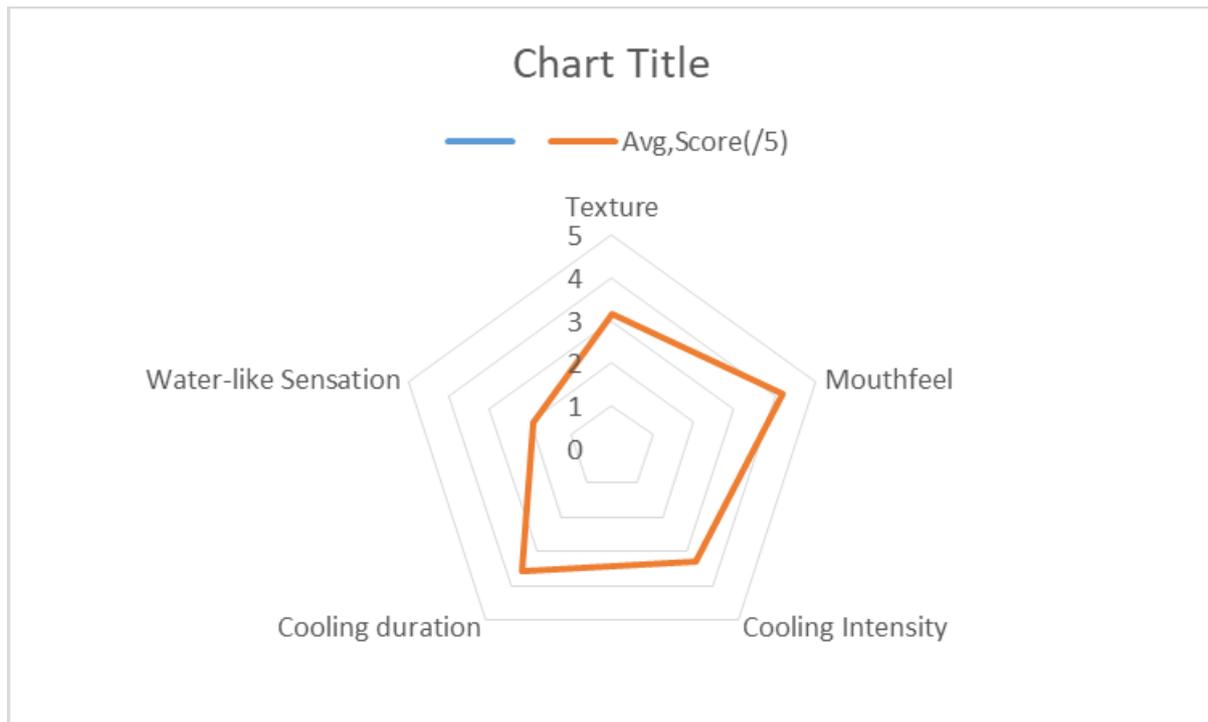


Figure 5: 5-Point scale sensory result spider chart

The 5-point radar chart (Figure X) represents a visual summary of participant feedback across the five advanced sensory attributes.

The chart shows:

- Mouthfeel and cooling duration reaching outward toward the higher end of the scale, confirming that CryoBites delivered a pleasant and lingering cool sensation.
- Cooling intensity plotted around the middle range (3.29), indicating that the cooling effect was moderate and balanced, avoiding extremes.
- Texture scored 3.17, supporting the idea that the bite was neutral to slightly firm, as intended.
- Water-like sensation, closest to the center at 1.92, clearly suggests a gap between expected and achieved ice-mimicking behaviour in mouthfeel.

4.4 Final Plating and Presentation

The plated dish followed a galactic theme inspired by futuristic concepts. CryoBites were arranged over a white plate coloured with black colour and dusted with powdered coconut, and freeze-dried berry powder in a spiral to resemble a galaxy. A fine sieve and soft brush were used to apply the powders in curved, radiating lines.

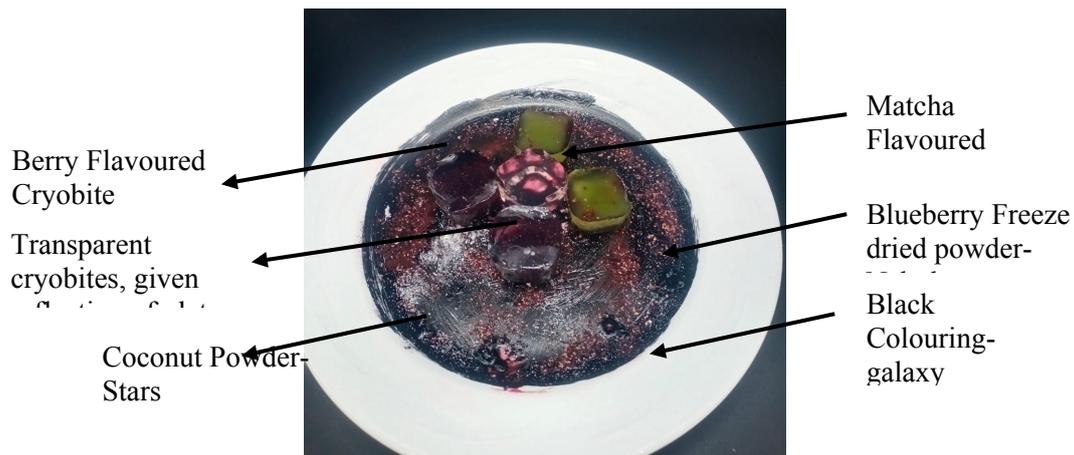


figure 6: Cryobites with Plating

5. Discussion

The CryoBites formulation was developed using note-by-note cooking principles to replicate the visual, textural, and sensory experience of ice cubes — but in a shelf-stable, non-melting format. Every ingredient used in the inner and outer layers played a specific structural or sensory role. The results of sensory evaluation support the overall success of the formulation in terms of acceptability, innovation, and future-oriented design, with some noted limitations.

5.1 Formulation design and ingredient functionality

CryoBites were formulated as a futuristic food product that replicates the sensory experience of eating an ice cube, getting the water sensation, but without melting. The product was created using the note-by-note cooking philosophy, which relies on pure compounds and precision formulation to create textures, tastes, and visual effects without traditional ingredients (Kitchentherdev, 2023).

The structure of CryoBites was formed using gellan gum as the matrix-forming agent. Gels, in general, are defined by a solid-like 3D matrix that maintains a continuous liquid phase and behaves elastically under stress (Oxford Cambridge New Delhi, n.d.). To achieve the structure of cryobites, gellan gum F (Low Acyl) was used as the primary hydrocolloid in both the inner flavoured cube and the outer transparent layer. Gellan gum is a high molecular weight polysaccharide gum formed by the fermentation of a carbohydrate by strains of *Pseudomonas elodea* (Europa.eu, 2019). There are two types of gellan gum: high acyl gellan gum and low acyl gellan gum. Low acyl gellan gum forms firm, brittle, ion-dependent, non-thermally reversible gels at low concentrations (~0.05%), whereas high acyl gellan forms elastic, soft and thermally reversible gels that are less ion-dependent and require higher concentrations (~0.2%) (Han, 2019).

In this formulation, Gellan Gum F (E418, MSK-1181) was used as the primary gelling agent. According to supplier information, this type is classified as a low acyl gellan gum, typically known for forming non-elastic, firm, brittle and thermo-irreversible gels (Morris et al., 2012).

However, in the current formulation, the gel produced by Gellan F was consistently soft and cohesive, allowing for smooth moulding and a pleasant, hydrated bite. This behavior is more commonly associated with high acyl gellan gum except the elasticity suggesting that either the functional properties of this specific commercial product differ slightly from standard classifications, or that formulation factors — such as the use of xylitol, glycerol, and controlled gellan concentrations — modified the texture outcome (Imeson, 2010; Grembecka, 2015).

By contrast, Gellan Gum LT100 (MSK-1089), which is categorised by the supplier as high acyl, yielded an extremely firm and hard gel in the second week and set too quickly to be moulded effectively. While in the third week trial, it did not form any gel (See weekly log books in the appendix). Although it is stated that Gellan Gum LT100 is fine mesh, high acyl gellan, which forms soft, elastic, non-brittle gels. It is soluble in hot water and has a set temperature of 70 - 80 °C. (Modernist Pantry, LLC, 2023). This contradiction between expected and observed properties highlights the importance of formulation context, brand variability, and empirical testing in note-by-note cooking.

By the fourth week of development, after conducting several trials and reviewing relevant literature, it became evident that Gellan Gum F (low-acyl) was the suitable choice for CryoBites. Unlike high-acyl gellan gums, which form elastic and thermally reversible gels, low-acyl gellan gum forms firm, brittle gels that better support structural stability. Since CryoBites are not intended to be elastic or chewy, but rather to deliver a cooling, water-like sensation without melting, the low-acyl formulation aligned perfectly with the product's goal. In contrast, Gellan Gum LT (high-acyl) was found to be unsuitable, as its thermo-reversible nature led to undesirable melting over time (Modernist Pantry, LLC, 2023).

For sweetness and a cooling sensation, erythritol was originally planned and used in the first three trials, but it was then replaced in the final formulation due to unavailability. Xylitol and Erythritol are sugar alcohols that can be used as low-calorie sweeteners (Gunnars, 2018). The reason for using Erythritol is due to its strong cooling effect when it dissolves in water due to the high negative heat of solution (Wikipedia, 2022). As a more important feature, erythritol can improve the mouth feeling and suppress the unwanted aftertastes, such as the irritant effect of intense sweeteners (Regnat, Mach and Mach-Aigner, 2017). The cooling effect of erythritol is very similar to that of xylitol and among the strongest cooling effects of all sugar alcohols (Wikipedia, 2022). Due to the unavailability of erythritol and its similarity with Xylitol, it was replaced with xylitol. Xylitol supports moisture retention, and has a smoother, less gritty texture than erythritol (Grembecka, 2015).

Glycerol was used in small quantities as a plasticiser and humectant for the outer layer of cryobites. It enhances the hydration and preserves food. (Wikipedia Contributors, 2019). It is often recommended as an additive when polyol sweeteners such as erythritol and xylitol are used, as its heating effect in the mouth will withstand these sweeteners' cooling effect (Nikolov, 2014). It contributed to a soft-melting sensation of a cryobite, mimicking the feeling of ice turning into water in the mouth. In addition to xylitol, a small quantity of stevia was also used in the formulation when erythritol was unavailable. Stevia, a high-intensity natural sweetener that

is used to boost the sweetness intensity without adding calories. Because stevia can have a slightly bitter aftertaste at higher concentrations, it was used in small amounts only, allowing xylitol to provide mouthfeel and volume (to, 2001)

To further enhance the cooling sensation, ice-like experience, menthol was added in a small quantity (approximately 1 g per 200 ml), particularly to the inner flavoured core. Menthol activates TRPM8 receptors in the mouth, triggering a sensory perception of cold without actual temperature change (McKemy, Neuhausser and Julius, 2002). This provided a layered cooling effect when combined with polyols and was especially effective in mimicking the experience of biting into a cold, flavoured ice cube.

The colour and flavour of the inner spheres were achieved using beetroot powder and strawberry extracts for the pink CryoBites, and matcha powder for the green variant. These ingredients were chosen for their natural, vibrant colours, shelf-stability, and alignment with sustainable food values.

The synergy between xylitol, stevia, and menthol ensured that the final product maintained a refreshing, sweet, hydrated and cool profile, even without erythritol. These substitutions also allowed the product to remain sugar-free, low-calorie, and compliant with modern dietary preferences and EU food regulations.

5.2 Preparation Process and Gelation Behaviour

The gelling process required heating the solution to 85–90°C to fully hydrate and activate the gellan gum, followed by immediate pouring into silicone moulds before gelation began (Cinogel.com, 2025). Structurally, CryoBites consist of a continuous gel matrix formed by gellan gum that traps water and flavour compounds within a stable three-dimensional network (Letizia Tavagnacco et al., 2023).

When gellan gum is dissolved in water and heated to above 85°C, the polymer chains become fully hydrated and unfolded. As the solution cools down, the gellan chains go through a coil-to-helix transition, aligning and aggregating to form a double-helix structure. These helices further aggregate into a three-dimensional network that entraps the liquid phase (Letizia Tavagnacco et al., 2023b).

In the outer transparent layer, a slightly higher gellan concentration (3g) creates a denser matrix with greater gel strength and surface tension, helping it form a clean, cube-like shell. The inner flavoured core, with slightly lower gellan content, forms a softer, more hydrated gel that provides a contrasting texture and more dynamic mouthfeel. This dual-layer approach replicates the structure of an ice cube with a cold, fluid-like core.

Importantly, the matrix is mechanically stable due to the absence of large ionic concentrations, but retains moisture and elasticity due to the presence of xylitol and glycerol, which disrupt some of the tight packing of helices and introduce flexibility into the gel (Nickerson, Paulson

and Speers, 2003). This results in a product that is both firm enough to hold shape and soft enough to replicate the bite of melting ice, especially when cooled.

5.3 Structural Integrity

All variations of the CryoBites maintained structural stability at room temperature and after refrigeration. The low-acyl gellan gum contributed significantly to the elasticity and structure stability of the product, preventing melting or deformation even after extended refrigeration. Glycerol, used in small quantities, enhanced the water-holding capacity and provided a soft, hydrated feel in the mouth, closely simulating the mouthfeel of melting ice. Menthol contributed a subtle cooling effect, reinforcing the cryogenic concept.

5.4 Regulatory Compliance and Permitted Use

All ingredients used in the CryoBites formulation comply with the current European Union food additive legislation, specifically under **Regulation (EU) No. 1333/2008** on food additives and **Regulation (EU) No. 231/2012**, which lays down specifications for authorised additives. The primary structuring agent, gellan gum (E418), is approved for use in various food categories. In this formulation, gellan gum was used at approximately 2.0–2.5%, which is above typical commercial levels, but within acceptable limits for small, portion-controlled servings and aligned with “quantum satis” principles in creative food applications (EFSA, 2018; EU Reg. 231/2012).

Xylitol (E967), used as the main sweetener, is permitted under quantum satis, meaning it can be used in quantities as needed for function and safety, without a specific maximum level, provided good manufacturing practices (GMP) are followed. However, as with other sugar alcohols, its inclusion requires a consumer warning that excessive consumption may cause laxative effects (European Commission, 2012). Glycerol (E422) was used at less than 1%, within its unrestricted use level as a humectant and texturiser under EU law.

Menthol, although not classified with an E-number, is permitted under Regulation (EC) No. 1334/2008 as a natural flavouring substance. It is generally recognised as safe (GRAS) and widely used in food and pharmaceutical products to impart a cooling effect at very low concentrations. The flavouring components, such as blueberry powder and matcha powder, are minimally processed and thus fall under the category of “flavouring compounds” rather than regulated additives, meaning they do not require E-numbers or maximum usage limits (EU Reg. 1333/2008 Annex II).

Together, these ingredients demonstrate full compliance with current EU food safety laws, and their selection reflects technical functionality and consumer acceptability, labelling transparency, and compatibility with future food innovations. Table 7, summarizes the ingredients with EU regulations.

Ingredients	Quantity Used	EU Permitted Level	EU Regulations
Xylitol (E967)	50g	Quantum Satis	Annex II & Annex III Regulation(EU) No 1333/2008
Stevia (960)	2g	ADI: 4mg/kg bw/day	Regulation(EU) No 1131/2011
Glycerol (E 422)	2g	Quantum Satis (GMP)	Regulation(EU) No 1333/2008
Gellan Gum F (E418)	5g	Quantum Satis	Regulation(EU) No 231/2012
Raspberry Natural Flavour	5ml	Comply with natural flavouring guidelines	Regulation(EU) No 1334/2008
Menthol	1g	Up to 0.1% in food or as GMP	EU Flavouring Guidelines
Concentrated Black food colour	Small amount	GMP	Regulation (EU) No 1333/2008

5.5 Sensory Analysis result Interpretation

The sensory analysis indicated that CryoBites successfully delivered a moderate to strong cooling sensation, validating the use of menthol and polyols. The texture was perceived as soft to somewhat firm, aligning with the intended gel structure. A majority of participants experienced a water-like mouthfeel, supporting the product's aim to replicate melting ice. Minor inconsistencies in clarity and flavor uniformity suggest areas for formulation refinement.

5.6 Food for the future

CryoBites were formulated with the future of food concept. They are easy to carry, don't melt easily, and don't need a fridge, making them perfect for places where fresh food isn't available, like deserts, disaster zones, or even space missions. Because they are made with note-by-note cooking, every part, i.e. the taste, texture, colour, and shape, is carefully controlled using pure compounds and no traditional food ingredients like fruits or dairy.

This kind of innovation fits perfectly with the United Nations' goals for 2030, which call for new food ideas to fight hunger, improve nutrition, and reduce waste. CryoBites represents how we can make personalised, stable, and enjoyable food products that are ready for the challenges of the future, whether on Earth or beyond.

6. Conclusion and Recommendation

The formulation of CryoBites successfully met the original aim of creating a non-melting, portable, and sensory-appealing ice-like product using note-by-note cooking techniques. The formulation delivered a firm yet hydrated texture and a realistic cooling sensation, simulating

the experience of melting ice without relying on actual freezing. The use of gellan gum F (low-acyl) proved suitable for achieving structural stability, while the combination of polyols and menthol effectively produced a cold sensation in the mouth. All ingredients used complied with EU food additive regulations, ensuring both safety and innovation.

CryoBites exemplify the concept of "Food for the Future" by addressing critical needs such as shelf stability, portability, and minimal dependence on traditional agricultural systems. This product is suitable for use in space missions, desert environments, and emergencies, all settings where conventional cold storage is not possible. It demonstrates how note-by-note formulation can enable sustainable, functional, and personalised nutrition.

It is recommended that future development focuses on improving optical clarity and refining the inner flavour cores for more uniformity. Further sensory testing with a larger panel can strengthen consumer insight and help optimise ingredients and formulations for targeted demographics and geographies.

CryoBites are not just a culinary innovation; they represent a forward-looking solution for tomorrow's food challenges.

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8. Appendix

Week 1

MODULE CODE: TFCS9025

MODULE TITLE: Molecular Gastronomy

STUDENT NAME: _____ Aqsa Hayat _____

FOOD PRODUCT: _____ Cryobites _____

WEEK NO.: 1
DATE: 18/3/2025

Weekly Aims and Objectives

Aims

The aim is to develop CryoBites, an innovative, non-melting, edible ice cube using note-by-note cooking. It is designed as a shelf-stable, futuristic food solution suitable for extreme environments such as space missions, deserts, or emergency nutrition, aligning with the future needs of sustainable and portable food systems.

Objectives

- To create a Stable transparent outer shell using hydrocolloids, gellan gum F.
- To create a stable flavoured inner core using gellan gum F.
- To check if the ingredients are in the right quantity
- Use erythritol, xylitol and menthol to produce a cooling effect.

Materials and Method (Ingredients, Equipment and Method)

Materials

For the Inner flavoured core of cryobites

Ingredients	Quantity	brand	picture
Water(Filterd)	100ml	Foruisce True water	
Erythritol	50g	E 968 Sosa Fresh (SOSA Code: 41494)	
Xylitol	5g	Xylitol(E967) Sosa	
Matcha Powder	5g		

Menthol Powder	3g		
Gellan gum F	2g	E418 MSK-1181 Batch: 54713	
Blueberry freeze-dried powder	2g	MSK-0774 Batch-52852	

For the Outer Non-Transparent outer layer

Ingredients	Quantity	brand	picture
Water(Filtered)	200ml	Foruisse True water	
Erythritol	100g	Sosa Fresh (SOSA Code: 41494)	
Xylitol	5g	Xylitol(E967)	
Gellan gum F	2g	MSK-1181 Batch: 54713	

Blueberry freeze-dried powder	2g	MSK-0774 Batch-52852	
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Equipments

Equipment	Brand	Picture
Weighing Balance		
Stove		
Temperature Probe	TP101	
Silicon ice cube moulds		
Freezer	b Broadericks 44230	

Methods

Prepare the Transparent Non-Flavoured Outer Layer

To prepare the outer transparent layer, 200 ml of water was heated to 60 °C to maintain its clarity. Once the desired temperature was reached, erythritol, Xylitol, and gellan gum F were slowly added while continuously whisking to prevent clumping and bubbling. The mixture was stirred for 2 minutes until fully dissolved. After preparation, the solution was removed from the heat and cooled slightly before pouring into moulds.

2. Prepare the inner core of Matcha & Berry Flavour

To prepare the Inner flavoured Core, 100 ml of water was heated up to 60 °C. Once the desired temperature was reached, Erythritol, xylitol and 2g of gellan gum F were slowly added while continuously whisking to avoid clumping. Menthol was then added, and the mixture was stirred continuously for 2 minutes until fully dissolved. When the mixture had developed, it was removed from the heat and divided into two bowls. In one bowl, 5g of matcha powder was added and thoroughly mixed. In the other bowl, 2g of Blueberry freeze-dried powder was added and mixed properly. Both mixtures were then cooled slightly before pouring into moulds.



3. Assemble the CryoBites

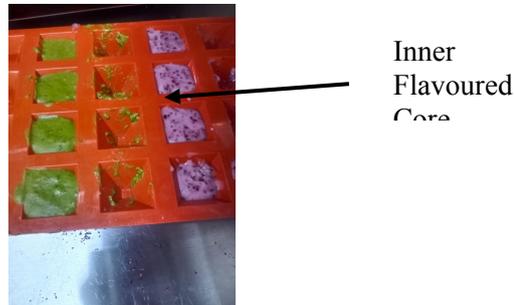
To assemble the cryobites into their proper shape, matcha and berry mixtures were poured into silicone moulds. They were placed in a fridge for 10 minutes. Once they had developed into their proper shape, they were unmoulded and transferred to another cubic silicon mould. A thin layer of transparent non-flavoured solution was poured, allowed to rest for 5 minutes, then the already developed matcha and berry inner core were added. Another layer of transparent solution was added on top. After resting for a while at room temperature, the cryobites were placed in a fridge for 15 minutes to observe their final structure and texture.



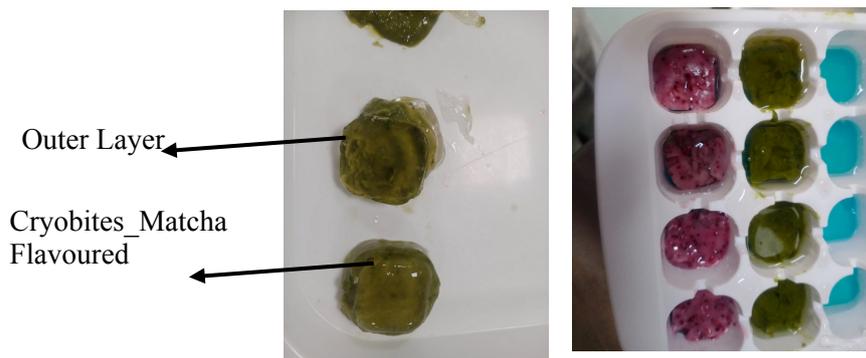
Results and Discussion

The inner matcha and berry-flavoured core structure developed well. But they were not firm. Unmolding them without deforming their shape required careful handling. This issue might be

related to the temperature Control, as they were not allowed to be set at room temperature before refrigeration. Additionally, during mixture preparation, adding all ingredients directly and continuously heating and stirring the gellan gum may have impacted its gellan properties. The quantity of gellan gum or the temperature at which it was added may not be optimal, resulting in a gel that was not firm enough.



The outer transparent layer was too soft and unstable, causing it to melt over time and allowing the inner core to break through. Although the cryobites held their shape initially, they lacked firmness and structural integrity. The taste and flavour were satisfactory but the texture issues were likely due to temperature control and possibly due to incorrect quantity of gellan gum.



Conclusions

The Cryobites had texture and stability issues, likely due to the inadequate temperature control and incorrect quantity of gellan gum. Despite these issues the taste and flavour was satisfactory. To improve the texture and stability of cryobites, adjusting temperature control and gellan gum quantity may be necessary.

Recommendations for the following week.

- Need to monitor temperature at every stage of developing cryobites.
- need to get the right mould.
- need to adjust the quantity of gellan gum.

Ingredients required for the following 2 weeks.

Glycerol

Gellan gum LT

Week 2

MODULE CODE: TFCS9025

MODULE TITLE: Molecular Gastronomy

STUDENT NAME: _____Aqsa

Hayat _____

FOOD PRODUCT:

_____Cryobites_____

WEEK NO.:__2__

DATE: __24/3/2025_____

Weekly Aims and Objectives

Aims

The aim is to develop CryoBites, an innovative, non-melting, edible ice cube using note-by-note cooking. It is designed as a shelf-stable, futuristic food solution suitable for extreme environments such as space missions, deserts, or emergency nutrition, aligning with the future needs of sustainable and portable food systems.

Objectives

- To create a Stable gel using hydrocolloids. gellan gum F was replaced by gellan gum LT(High acyl).
- Gellan gum quantity increases from 2g to 5g for a better texture of flavoured inner core.
- To lock moisture, use 3g glycerol as a humectant and prevent drying

- The temperature is increased from 60°C to 90°C.
- Add 10ml of Raspberry extract to enhance the flavour of the inner core.
- Use erythritol and xylitol to produce a cooling effect.
- Use a Flash freezer to see its effect on the final texture of cryobite

Materials and Method (Ingredients, Equipment and Method)

Materials

For the Inner flavoured core of cryobites

Ingredients	Quantity	brand	picture
Water(Filtered)	100ml	Foruisse True water	
Erythritol	50g	Sosa Fresh (SOSA Code: 41494)	
Xylitol	5g	Xylitol(E967)	
Matcha Powder	5g		
Menthol Powder	3g		
Gellan gum LT	5g	MSK-1181 Batch: 54713	

Blueberry freeze-dried powder	2g	MSK-0774 Batch-52852	
Raspberry oil soluble flavour	10ml	MSK-1442	

For the Outer Non-Transparent outer layer

Ingredients	Quantity	brand	picture
Water(Filtered)	200ml	Foruisce True water	
Erythritol	100g	E 968 Sosa Fresh (SOSA Code: 41494)	
Xylitol	5g	Xylitol(E967) Sosa	
Glycerol	3g		

Gellan gum LT	2g	MSK-1181 Batch: 54713	
Blueberry freeze-dried powder	2g	MSK-0774 Batch-52852	

Equipments

Equipment	Brand	Picture
Weighing Balance		
Stove		
Saucepan		
Whisk		
Temperature Probe	TP101	

Silicon ice cube moulds		
Freezer	b Broadericks 44230	

Methods

Prepare the Outer Transparent Non-Flavoured Layer

To prepare the outer transparent layer, 200 ml of water was heated to 90 °C. Once the desired temperature is reached, erythritol, Xylitol, and gellan gum LT are slowly added while continuously whisking to prevent clumping and bubbling. Glycerol was then added to retain moisture in final product. The mixture was stirred for 2 minutes until fully dissolved. After preparation, the solution was removed from the heat and cooled slightly before pouring into moulds.

2. Prepare the inner core of Matcha & Berry Flavour

To prepare the Inner flavoured Core, 100 ml of water was heated up to 90 °C. Once the desired temperature was reached, Erythritol, xylitol and 5g of gellan gum LT were slowly added while continuously whisking to avoid clumping. Menthol was then added, and the mixture was stirred continuously for 2 minutes until fully dissolved. When the mixture had developed, it was removed from the heat and divided into two bowls. In one bowl, 5g of matcha powder was added and thoroughly mixed. In the other bowl, 2g of Blueberry freeze-dried powder and 10 ml of Raspberry flavour were added and mixed properly. Both mixtures were then cooled slightly before pouring into moulds.

3. Assemble the CryoBites

To assemble the cryobites into their proper shape, matcha and berry mixtures were poured into silicone moulds. They were placed in a fridge for 10 minutes. Once they had developed into

their proper shape, they were unmolded and transferred to another cubic silicon mould. A thin layer of transparent non-flavoured solution was poured, allowed to rest for 5 minutes, then the already developed matcha and berry inner core were added. Another layer of transparent solution was added on top. After resting for a while at room temperature, the cryobites were placed in a fridge for 15 minutes to observe their final structure and texture.

Results and Discussion

The inner matcha and berry-flavoured core structure did not develop well because the gel started setting in the saucepan while being stirred, making it almost impossible to mould. This might be due to inadequate temperature control or the type of gellan gum used, such as high acyl gellan gum, which can affect the desired texture. The outer transparent layer was too hard and firm, which was unexpected. The hardness of cryobites made it hard to bite, rendering them unusable. It was likely due to temperature control and possibly due to the type of gellan gum. Additionally, flash freezing caused ice-crystals to form on the surface, giving them a foggy appearance.



Conclusions

The formulation of cryobites faced several challenges, including improper gel setting, hard outer layer texture, and ice crystal formation during flash freezing. These issues likely resulted from using incorrect gellan gum, temperature control or both. Adjusting these factors may help achieve the desired texture and appearance.

Recommendations for the following week.

- Need to monitor temperature at every stage of developing cryobites.
- need to get the right mould.
- need to adjust the quantity of gellan gum.
- need to test high acyl gellan gum.

Ingredients required for the following 2 weeks.

Concentrated gel food colouring black.

Coconut Powder

Blackberry Powder

Week 3

MODULE CODE: TFCS9025

MODULE TITLE: Molecular Gastronomy

STUDENT NAME: _____Aqsa

Hayat_____

FOOD PRODUCT:

_____Cryobites_____

WEEK NO.:__3__

DATE:__07/04/2025_____

Weekly Aims and Objectives

Aims

The aim is to develop CryoBites, an innovative, non-melting, edible ice cube using note-by-note cooking. It is designed as a shelf-stable, futuristic food solution suitable for extreme environments such as space missions, deserts, or emergency nutrition, aligning with the future needs of sustainable and portable food systems.

Objectives

- To create a Stable gel using hydrocolloids, Gellan gum LT(High Acyl) was used.
- To monitor the temperature at every step.
- Add 2d of colouring black, coconut powder and blackberry powder for plating.
- Use a Plastic cover over cryobites to prevent ice crystals over it.

Materials and Method (Ingredients, Equipment and Method)

Materials

For the Inner flavoured core of cryobites

Ingredients	Quantity	brand	picture
Water(Filterd)	100ml	Foruisce True water	
Erythritol	50g	Sosa Fresh (SOSA Code: 41494)	
Xylitol	5g	Xylitol(E967)	
Matcha Powder	3g		
Menthol Powder	3g		
Gellan gum LT	3g	MSK-1181 Batch: 54713	
Blueberry freeze-dried powder	2g	MSK-0774 Batch-52852	
Raspberry oil-soluble flavour	10ml	MSK-1442	

For the Outer Non-Transparent outer layer

Ingredients	Quantity	brand	picture
Water(Filtered)	200ml	Foruisse True water	
Erythritol	80g	E 968 Sosa Fresh (SOSA Code: 41494)	
Xylitol	5g	Xylitol(E967)	
Glycerol	3g		
Gellan gum LT	4g	MSK-1181 Batch: 54713	
Blueberry freeze-dried powder	2g	MSK-0774 Batch-52852	

Equipments

Equipment	Brand	Picture
Weighing Balance	CAMRY	
Stove	Gas Stove	
Saucepan	Steel	
Whisk	Steel	

Temperature Probe	TP101	
Silicon ice cube moulds	Silicon	
Freezer	b Broadericks 44230	

Methods

Prepare the Outer Transparent Non-Flavoured Layer

To prepare the outer transparent layer, 200 ml of water was heated to 90 °C. Once the desired temperature is reached, erythritol, Xylitol, and gellan gum LT are slowly added while continuously whisking to prevent clumping and bubbling. Glycerol was then added to retain moisture in the final product. The mixture was stirred for 2 minutes until fully dissolved. After preparation, the solution was removed from the heat and cooled slightly before pouring into moulds.

2. Prepare the inner core of Matcha & Berry Flavour

To prepare the Inner flavoured Core, 100 ml of water was heated up to 90 °C. Once the desired temperature was reached, Erythritol, xylitol and 3g of gellan gum LT were slowly added while continuously whisking to avoid clumping. Menthol was then added, and the mixture was stirred continuously for 2 minutes until fully dissolved. When the mixture had developed, it was removed from the heat and divided into two bowls. In one bowl, 3g of matcha powder was added and thoroughly mixed. In the other bowl, 2g of Blueberry freeze-dried powder and 10 ml of Raspberry flavour were added and mixed properly. Both mixtures were then cooled slightly before pouring into moulds.

3. Assemble the CryoBites

To assemble the cryobites into their proper shape, matcha and berry mixtures were poured into silicone moulds. They were placed in a fridge for 10 minutes. Once they had developed into their proper shape, they were unmolded and transferred to another cubic silicon mould. A thin layer of transparent non-flavoured solution was poured and allowed to rest for 5 minutes. Then, the already developed matcha and berry inner core were added. Another layer of transparent solution was added on top. After resting for a while at room temperature, the cryobites were placed in a fridge for 15 minutes to observe their final structure and texture.

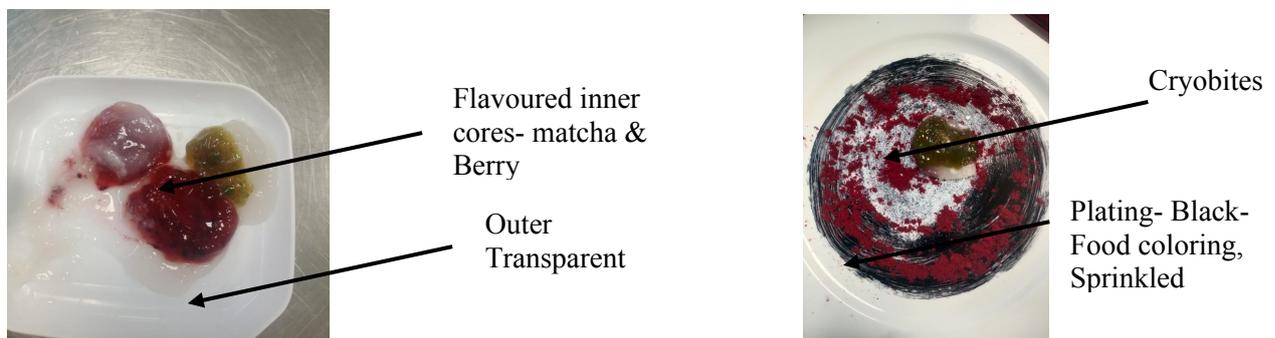
4. Plating

For the final presentation, a matte black colour was done using the brush on a round white plate to enhance the contrast of the dish components. A galaxy style was created using a variety of edible powders to mimic a cosmic spiral. Coconut powder, freeze-dried berry powder, and beetroot powder were distributed in a spiral formation using fine sieves and a pastry brush, creating a layered, radiant galaxy design. CryoBites were arranged in center.

Results and Discussion

I encountered an issue with the structure of the mixture after it was removed from the freezer. Initially, the mixture seemed fine while it was being prepared on the stove. However, after it cooled down and was poured into moulds, placed in the freezer, and subsequently removed, the structure failed to develop as expected. Instead, the mixture melted and did not retain its shape.

I believe the issue may be attributed to temperature effects. Specifically, the mixture did not have sufficient time to set properly in the moulds before being placed in the freezer. Additionally, the type of gelling agent used, high acyl gellan gum, might not have been suitable for this particular application. The same type of gellan gum was used in the last trial, where it formed the hard gel that was even unable to break and eat, but in this trial, I tried to change the ratio and used the same type, but it did not go well.



During the preparation process, the mixture seemed to be working well, but the final product did not meet expectations. To improve the outcome, I would need to adjust the cooling and setting process, potentially allowing the mixture to set in the moulds at room temperature before freezing. Furthermore, experimenting with different types or ratios of gelling agents might be necessary to achieve the desired texture and structure.

To overcome the issues encountered, I plan to revisit the recipe and process, focusing on optimising the cooling and setting stages. By making adjustments to the temperature control and gelling agent, I aim to achieve a more stable and desirable structure in the final product.

When it comes to plating, the cryobites' lack of structure and stability became apparent. The product did not hold its shape or maintain its desired appearance, which affected its overall presentation.

Conclusions

The plating method achieved its result but cryobites still need a stability

Recommendations for the following week.

- Need to try gellan gum F to see its effect on my final product
- Need to monitor the time and temperature at every step.

Ingredients required for the following 2 weeks.

Edible silver glitter

Week 4

MODULE CODE: TFCS9025

MODULE TITLE: Molecular Gastronomy

STUDENT NAME: _____ Aqsa

Hayat _____

FOOD PRODUCT:

_____ Cryobites _____

WEEK NO.: __ 4 __

DATE: __ 31/3/2025 _____

Weekly Aims and Objectives

Aims

The aim is to develop CryoBites, an innovative, non-melting, edible ice cube using note-by-note cooking. It is designed as a shelf-stable, futuristic food solution suitable for extreme environments such as space missions, deserts, or emergency nutrition, aligning with the future needs of sustainable and portable food systems.

Objectives

- To create a stable structure using gellan gum F (Low acyl).
- To monitor the temperature at every step.
- To finalize my whole product with plating
- Perform Sensory Analysis

Materials and Method (Ingredients, Equipment and Method)

Materials

For the Inner flavoured core of cryobites

For the Inner flavoured core of cryobites

Table 1: Ingredients used in each recipe presented below

Ingredients	Quantity	Specification	picture
Water(Filtered)	200ml	Foruisse True water	
Xylitol	25g	Xylitol(E967) Sosa	
Matcha Powder	3g	Sosa code 41460	
Menthol	2g	N/A	N/A
Stevia	2g	E 960	N/A
Gellan gum F	2g	E 418 MSK-1181 Batch: 54713	
Blueberry freeze-dried powder	3g	MSK-0774 Batch-52852	
Raspberry oil-soluble flavour	5ml	MSK-1442/44869	

For the Outer Transparent outer layer

Table 2

Ingredients	Quantity	brand	picture
Water(Filterd)	150ml	Foruisce True water	
Xylitol	25g	Xylitol(E967)	
Gellan gum F	3g	E 418 MSK-1181 Batch: 54713	
Glycerol	3g	E 422	N/A
Menthol	1g	N/A	N/A

For Plating

Table 3

Ingredients	Quantity	Specification	Picture
Concentrated gel food colouring Black	1g	Colour Splash Classic	
Coconut Powder	1g	Sosa	
Blueberry Freeze-Dried powder	1g	MSK	

Equipment

Table 4: Equipment used in the preparation of each recipe presented below

Equipment	Specification	Picture
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Weighing Balance	CAMRY	
Stove	Gas Stove	
Saucepan		
Whisk	Steel	
Bowl	Steel	
Temperature Probe	TP101	
Silicon ice cube moulds	Silicon	
Refrigerator	b Broadericks 44230 (precision -18)	
Plate	Used for plating	
Brush	Wood brush for coloring	

Methods

The CryoBites were developed using a Note-by-Note culinary approach, incorporating pure compounds instead of traditional food ingredients. The methodology was divided into two key phases: formulation of the flavoured inner core and creating a transparent outer layer.

Flavoured Inner Core

To develop the flavoured inner layer of cryobites, all the ingredients were weighed using a weighing balance. 200 ml of water was heated up to 90 °C. Once the desired temperature was reached, xylitol, Stevia and 3g of gellan gum F(Low acyl) were slowly added while continuously whisking to avoid clumping. Menthol was then added, and the mixture was stirred continuously for 2 minutes until fully dissolved. When the mixture had developed, it was removed from the heat and divided into two bowls. In one bowl, 3g of matcha powder was added and thoroughly mixed. In the other bowl, 3g of Blueberry freeze-dried powder and 5 ml of Raspberry flavour were added and mixed properly. Both mixtures were then cooled slightly before pouring into moulds.

Preparation of Outer Transparent Layer

To prepare the outer transparent layer, 150 ml of water was heated to 90 °C. Once the desired temperature is reached, Xylitol, stevia and gellan gum F were slowly added while continuously whisking to prevent clumping and bubbling. Glycerol was then added to retain moisture in the final product. The mixture was stirred for 2 minutes until fully dissolved. After preparation, the solution was removed from the heat and cooled slightly before pouring into moulds.

Preparation of fully transparent cryobites

In parallel, a batch of fully transparent CryoBites was prepared using the same outer gel matrix, but without incorporating any inner core. These cubes were designed to resemble frozen, crystal-like structures, intentionally minimal in flavour and colour to enhance the visual illusion of floating ice cubes. This version served as a contrast to the dual-layered CryoBites and allowed visual balance during final plating.

Assemble the CryoBites

To assemble the cryobites into their proper shape, matcha and berry mixtures were poured into small cubic-shaped silicone moulds. They were placed in a fridge for 10 minutes. Once they had developed into their proper shape, they were unmolded and transferred to another large cubic silicon mould. A thin layer of transparent non-flavoured solution was poured and allowed to rest for 5 minutes. Then, the already developed matcha and berry inner core were added. Another layer of transparent solution was added on top. After resting for a while at room temperature, the cryobites were placed in a fridge for 15 minutes to observe their final structure and texture.

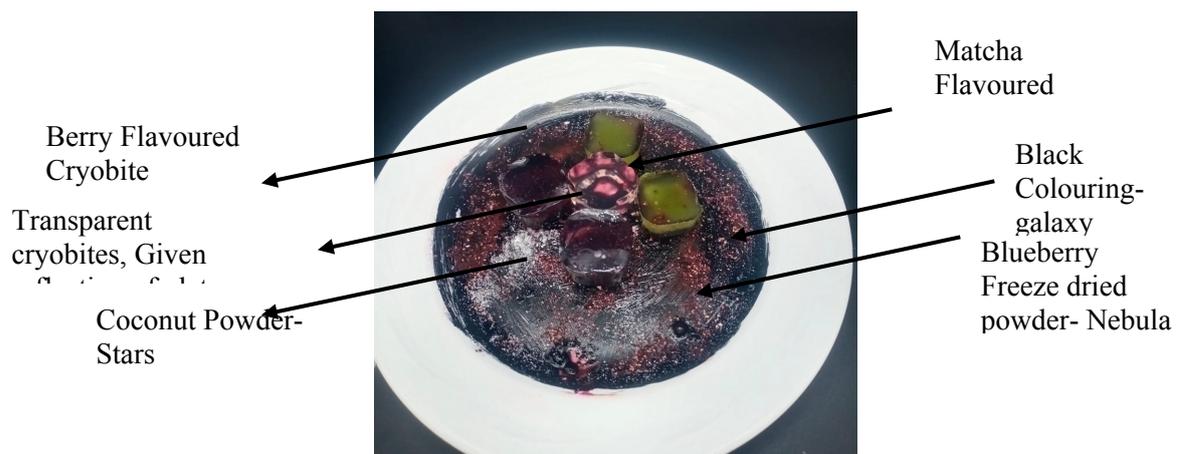
2.2.4 Final Plating and galaxy design

For the final presentation, a matte black colour was done using the brush on a round white plate to enhance the contrast of the dish components. A galaxy style was created using a variety of edible powders to mimic a cosmic spiral. Coconut powder, and freeze-dried berry powder, were distributed in a spiral formation using fine sieves and pastry brushes, creating a layered, radiant galaxy design.

CryoBites were arranged centrally, alternating between transparent and dual-layered versions. This multisensory approach was intended to simulate an interstellar experience while reflecting the possibilities of note-by-note innovation for the future of food.

Results and Discussion

In the fourth trial, i successfully created the desired structure and texture of Cryobites. The structure was stabilized due to two key factors: the use of the right type of gellan gum and precise temperature control. specifically , i monitored the temperature at every step, stirred the mixture for 3 minutes at a temperature below boiling point, and allowed it to set at room temperature before referigerating it.



Although the plating could be improved, the trial was otherwise successful. A detailed sensory analysis was conducted, and the results are included in the final report.

Conclusions

The Fourth trial proved to be successful in terms of desired texture and structure. While there is a room for improvement in terms of plating, the sensory analysis provided valuable insights that will inform future trials. The result of this trial demonstrates progress toward achieving the desired product characteristics.

Recommendations for the following week.

Ingredients required for the following 2 weeks.

