NOTE-BY-NOTE REPORT

Food for the Future: A Sustainable, Galactic Dessert

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1. Introduction

Molecular gastronomy has revolutionized the way we think about and prepare food with scientists and chefs now manipulating ingredients at the molecular level to construct entirely new forms, textures, and flavors. The process combines culinary imagination with chemical reactions, opening the potential for further experimentation with taste, texture, and appearance. The newest and possibly most radical division of this emerging science is note-by-note (NbN) cooking, invented by physical chemist Hervé This. Rather than conventional cooking which is founded on whole foods such as vegetables, meats, and grains, NbN cuisine constructs foods from pure molecular ingredients, such as water, proteins, carbohydrates, fat, and other functional additives (This, 2021). Not only does it change how we make food, but it also reimagines food's ability to address nutritional content, sustainability, and artistic expression.

Note-by-note cuisine is particularly relevant in the context of global threats to food security and sustainability. As we move towards a more crowded future with climate change and disrupted agriculture and food systems, NbN cuisine offers a new way to redesign food. It enables foods to be engineered with precise macronutrient profiles, extended shelf life, and reduced dependence on traditional farming, all without compromising or even enhancing the sensory experience. Note-by-note cooking has implications far more extensive than solely within the food scene, with the potential to address international food insecurity, climate disruption, and resource deficiency. With over 690 million people hungry and with malnutrition globally, a situation further exacerbated by the COVID-19 pandemic, it is essential to begin to envision how food systems can not only supply food but also are efficient and equitable (United Nations, 2020). NbN cuisine presents a new way of thinking and cooking where foods can be engineered to be precisely formulated, waste-reducing, and nutritionally optimized without depending on conventional farming or fragile supply chains.

The note-by-note dish, "Saturn and the Galaxy", explores these themes as a tribute not only to the food science but also to humankind's desire to venture into the outer space. It contains three signature components, each symbolizing something new in the external world: spherical gel foundation to symbolize Saturn, sugar lattice ring to symbolize Saturn's rings, and berry foam to symbolize the Milky Way. Together, these components combine to break culinary boundaries by fusing culinary creativity with scientific function. The result is a visually appealing, textured, and thought-out food with the goal of developing future food systems that are tailored to the individual.

2. Aim of the Assignment

The aim of this assignment was to consider how note-by-note (NbN) cuisine can be used to solve the world's future food issues. Global authoritative reports and action plans, such as those of the Food and Agricultural Organization and the UN Food Systems Summit, detail the need for future food systems to be sustainable, efficient, and able maintain global nutrition and ecological

balance (FAO, 2018). This project sought to build these ideas using the functional and creative composition of a space-food dish made of only pure molecular ingredients.

Note-by-note cooking, as defined by Hervé This, involves building culinary foods from isolated food molecules such as water, amino acids, carbohydrates, lipids, minerals, and flavor compounds. NbN cooking eliminates the use of raw materials from farms, which tend to be vulnerable to perishability, environmental stresses, and distribution issues. NbN cuisine therefore has a huge potential in food sustainability, customization, and versatility, inherent goals which are part of the Sustainable Development Goals (SDGs) and the 2030 Agenda (United Nations, 2015).

The challenge was to determine how NbN philosophy could realistically be applied to design a futuristic and applicable dish that is innovative and technically sound. The dessert, "Saturn and the Galaxy," used space as a symbol for innovation and sustainability. The subject was chosen to symbolize the scientific part of note-by-note cuisine and trigger creative thought about the issue of food under extreme or pioneering conditions including space, urban food shortages, or customized nutrition.

Overall, the aim of this dish was to discover how the aesthetic of future food can not only solve the world's food issues but also capture the imagination through artistic and symbolic presentation. The main objective was to formulate a novel dessert that was unique in texture and appearance using only pure compounds. The dish comprised three main components:

- A gel base with the shape of Saturn, made up with hydrocolloids like agar and xanthan gum to provide structure and elasticity.
- A sugar ring lattice, taking the form of Saturn's well-known rings, achieved by manipulating isomalt and trehalose to achieve crunch and structure.
- A berry foam to depict the Milky Way, made through aeration techniques using lecithin to achieve a light, galaxy-textured foam.

Each of these was based on a thorough understanding of food components and functional additives. Hydrocolloids provided the technology for the creation of gel strength and elasticity. Lecithin-type emulsifiers stabilized foam air bubbles, and sugar chemistry enabled the assembly of weak, edible lattices. Together, these ingredients created a multi-textured, visually beautiful dish that not only captures the appearance of space but also illustrates how note-by-note cooking can become a blueprint for the future of food, where art, ecology, and science merge as one.

3. Materials and Methods

3.1 Materials

Saturn Panna Cotta Gel Base:

- 40g coconut milk powder
- 200 ml water
- 2 drops of pistachio flavor from sosa
- 25g vanilla syrup
- 0.2g salt
- 2 g agar agar
- 0.5 g xanthan gum
- 0.02g yellow coloring
- 0.02g red coloring

Sugar Lattice Rings:

- 100 g isomalt
- 5 g trehalose
- 5 drops of lime flavor
- 0.02 g yellow coloring

Berry Foam:

- 15g dried blackberry powder
- 5g coconut milk powder
- 20g vanilla syrup
- 190g water
- 10g albuwhip
- 1g xanthan gum
- 2g lecithin

*More information on EU limits and ingredient brands can be found in the appendix.

For the preparation of these individual components, the following equipment was used:

- Immersion blender (robot coupe, mini mp 160 v.v.)
- Stainless steel mixing bowls
- Whisk
- Saucepan
- Spherical molds
- Food scale
- Parchment paper

3.2 Methods

3.2.1 Preparation of the Gel Base

1. Combine coconut milk powder, water, pistachio flavor, vanilla syrup, food coloring, and salt
2. Heat mixture until powder is fully dissolved

3. Add xanthan gum and mix to dissolve
4. Rehydrate agar agar powder with 2 tablespoons of water
5. Add the agar agar paste to the coconut mixture and bring to a simmer for 3 minutes at ~80°C
6. Allow to cool for 2 minutes
7. Pour into the sphere molds and allow to set in the fridge for at least 40 minutes until the gel is firm

3.2.2 Preparation of Sugar Lattice Rings

1. Melt isomalt with trehalose over medium heat until reaching 160°C.
2. Pour onto a silicone mat in a circular pattern to mimic rings.

3.2.3 Preparation of Berry Foam

1. Blend blackberry powder, water, and trehalose and mix until fully dissolved
2. Add lecithin, xanthan gum, and albuwhip and use an immersion blender to aerate the mixture for 2–3 minutes until a stable foam forms.
3. Let the foam stabilize for 2 minutes before plating.

4. Results

Figure 1: The final plating and presentation of "Saturn and the Galaxy"

As seen in Figure 1, the NbN dish met the visual and textural objectives set at the start of this project. All the components were well executed and maintained stability during plating.

The combination of agar agar and xanthan gum produced a silky, half-firm panna cotta-like gel that had an appealing texture and flavor. The gel was firm enough to hold the spherical shape while also soft, as it melted in the mouth. Coconut and vanilla flavors combined to give a subtle sweetness and a well-balanced gel. The sugar lattice rings were constructed from trehalose and isomalt, which provided both surface gloss and internal stability. The mixture was poured into spherical shapes to resemble Saturn's rings. The mixture cooled rapidly and remained crisp at room temperature without sticking or becoming too brittle. The sugar lattice added a complementing structural component to the dish that balanced well with the coconut gel. The blackberry foam used lecithin, xanthan gum and albuwhip to develop a light yet stable foam that maintained its structure upon plating for multiple minutes. The foam added a dynamic visual element and fruity fragrance to the dish that paired well with the creaminess of the panna cotta gel.

A small sensory analysis was performed within the kitchen and was made up of 9 panelists. The following were the results from the survey:

- 100% said it was visually appealing and mimicked Saturn.
- 66% said it was ‘slightly sweet’, 22% ‘well balanced’.
- 100% said the flavors of the components complement each other.
- Mouthfeel was described as soft and moist.
- 4.8/5 overall likeability (Figure 2).

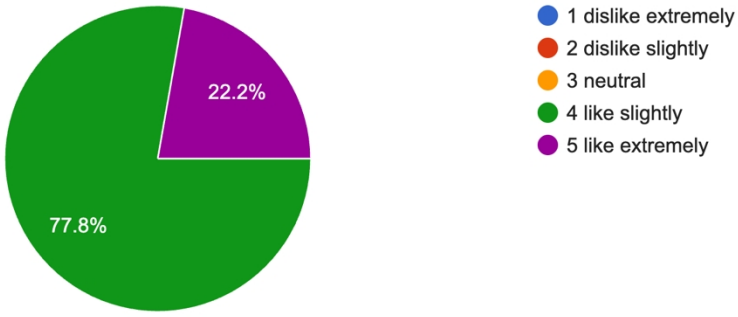

Figure 2: Responses for overall opinion of the space-themed dish.

The dish's visual presentation, depicting Saturn and the galaxy, served to successfully market the engagement aspect of the project. Its celestial look helped in repositioning synthetic food as an innovative and appealing alternative, which will be more acceptable to consumers. The gel network structure of the foam also allows for easy integration of micronutrient enrichment, sugar reduction, or protein augmentation, which can encourage the incorporation of personalized nutrition in everyday foods.

Overall, the dish successfully achieved a visually compelling representation of Saturn and the galaxy. The spherical gel base had a smooth texture with slight elasticity, closely resembling a

planet. The sugar lattice rings were crisp, durable, and maintained their structure. The berry foam remained stable for an extended period, forming a Milky Way effect. The additional hydrocolloids improved the stability and consistency of each component. The textures and tastes developed through NbN techniques displayed clear innovation. Gelling, crystallization, and foaming created a novel sensory experience unlike with traditional food preparations. This suggests that NbN food can potentially provide new, individualized food shapes for future foods. Additional information on the goals and objectives from week to week of this project can be found in the appendix under the logbook section.

5. Discussion

The understanding of molecular gastronomy was critical to the success of this dish. Through the formulation of components using molecular cooking techniques like gelling and crystallization, the NbN dish successfully created diverse textures and flavors that melded together.

Used in the coconut gel, agar agar is a red algae-derived hydrocolloid which forms into a heat-set, firm gel after dissolving it in hot water and allowing it to cool down. Agar has been utilized in this dish to give shape to the structure of a coconut panna cotta sphere so that it would maintain the gel structure while melting in mouth with a slightly elastic mouthfeel. Xanthan gum was added in small quantities to help maintain the viscosity of the mixture and prevent separation while setting. This combination of the hydrocolloids provided complete textural control and contributed to the engineered texture of this component of the dessert.

Used in the berry foam, lecithin is a natural emulsifier that lowers surface tension between liquids and air, allowing stable foams to be formed. It was combined with Albuwhip, a dehydrated egg white protein, to create a stable berry foam. The Albuwhip provided protein structure to retain the air while lecithin stabilized the bubbles. This yielded a light foam that replicated the Milky Way and offered a nice fruity flavor and airy texture. Isomalt is a sugar derivative from beet sugar that has high thermal stability and resistance to crystallization, which makes it good for sculpting sugar. It was mixed with trehalose, a disaccharide, to form delicate rings, which were then molded into a Saturn ring pattern. The cooking techniques of gelation, crystallization, and foaming are examples of the versatility of molecular cooking. With the possible poor quality of conventional whole food ingredients, molecular cooking uses pure compounds to achieve a reproducible food product. This positions note-by-note cuisine as a pragmatic toolset for future chefs, scientists, and food engineers.

The visual staging of the celestial dessert provided a persuasive story that matched the theme "Food for the Future." As the public becomes increasingly interested in food origin, health, and sustainability, conceptual and visual narrative becomes extremely important. The space theme not only conveyed exploration and progress but also made the concept of synthetic cooking more appealing by associating it with imagination and celestial visuals rather than artificial ingredients. Furthermore, the project examined the potential for using NbN food to apply individualized nutrition to foods (This, 2018). One can easily adjust sweetness, protein content, and vitamin addition to customize foods to a person's health needs or preferences. This flexibility can become a key to future health care systems and disease prevention diet models.

The results of this project confirm the viability and value of note-by-note cuisine as a means of meeting the challenges of future foods. By creating visually appealing, nutritionally adaptive, and environmentally friendly dishes from pure compounds, we can address the need for sustainable food innovation. Using shelf-stable molecules as a replacement for traditional raw materials, the dessert illustrates ways we can reduce food waste, optimize logistics, and support food security for low-income communities with limited access to farms. This also addresses the even more ambitious goals for mitigating food system vulnerabilities, especially in the wake of crises such as the COVID-19 pandemic, that revealed fragility within global food supply chains.

In short, the project demonstrates how note-by-note cuisine can create a sustainable and creative future for food. It can be used to expand food equity, reduce carbon footprint, contribute to culinary expression or develop nutritional personalization. The "Saturn and the Galaxy" dish is an applied example of what food can be in the future when science and creativity converge.

The project demonstrated the potential of note-by-note cuisine in crafting innovative, futuristic dishes. Further experimentation with this dish could involve:

- *Color Enhancements:* Utilizing natural pigments such as spirulina to deepen color contrast rather than artificial.
- *Texture Modifications:* Adjusting xanthan gum concentrations to refine the mouthfeel of the gel base and foam.
- *Long-Term Stability:* Exploring alternative foaming agents such as methylcellulose to extend foam longevity.

These refinements could elevate the dish's overall presentation and longevity, making it a viable option for future culinary showcases.

6. Conclusions

This project showed the potential of note-by-note cuisine in response to the current challenges facing food systems across the world. By creating a space-themed dessert, this task demonstrated how gastronomy techniques can be applied to create innovative textures and appealing visuals. These methods pave the way for future culinary innovations, aligning with the theme of food for the future.

Each component of the dish was made with pure molecular compounds like agar agar, xanthan gum, lecithin, and isomalt. The incorporation of hydrocolloids, alternative sweeteners, and emulsifiers demonstrated the versatility of molecular cooking in achieving specific sensory results. These ingredients allow for control over structure, flavor, and stability, making cooking more consistent and adaptable. This emphasizes the argument that NbN cuisine is not only useful in experimental gastronomy but also implementable on broader applications, specifically where traditional ingredients are scarce or unsustainable.

The dessert also addressed future food priorities like sustainability, nutritional adjustability, and the engagement of consumers. By steering away from agricultural and long-shelf-life materials, the dish limited the waste of food and use of resources. The modular nature of NbN cooking

allows easy adaptation to meet specific nutritional needs, enabling reduction of sugar, increasing micronutrient levels, and protein fortification which is useful for designing custom diets and preventive health programs for future food systems.

Moreover, the space-age, futuristic theme employed assisted in making consumers more accepting of NbN cooking through the rendering of synthetic food as imaginative and appealing. The presentation and storytelling of the meal demonstrated how cuisine design can make the populace embrace new food technology.

7. References

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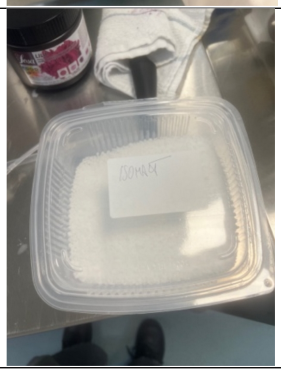
8. Appendix

Table 1: Ingredient list with amounts and EU limit.

Name	Amount	Recommended Amount per EU legislation	Image

Sosa Coconut Milk Powder	40g	n/a	
Sosa Pistachio Flavor	2 drops ~ 0.2g/kg	0.2g/kg	
Vanilla Syrup	25g in gel 20g in foam	10-60 g/L	
Lecithin	2g	Max 20g/kg	

Sosa Lime Flavor	1 drops ~ 0.1g/kg	0.2g/kg	
Sosa Albuwhip	10g ~ 40g/kg	81-100g/kg	
SpecialIngedients Agar Agar	2g	2-10g/kg	
Innovative Naturopathics Trehalose	5g	n/a	

Yellow Food Coloring	.02g	.045g/kg	
Red Food Coloring	.02g	.045g/kg	
Xanthan gum	0.5g	2-5g/kg	
Isomalt	100g	n/a	
Sosa Dried Blackberry Powder	15g	Quantum satis (as much as needed)	

8.1 Logbooks

Week 1

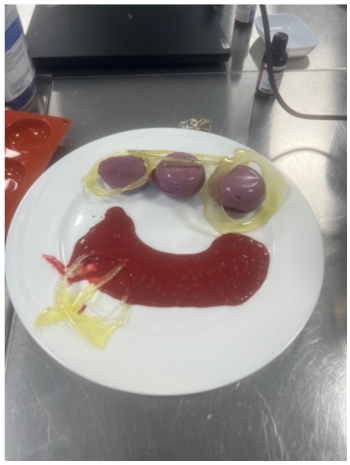
Aims/objectives: Begin initial formulation for the three primary components of the note-by-note dish. The goal is to explore textures, flavors, and presentation techniques. My main goal is to create a cohesive dish with varying textures and flavors that all complement each other well.

Actions Taken:

- Developed a base recipe for a coconut panna cotta sphere using agar agar as the gelling agent
    - Combine: 40 g coconut milk powder, 200 ml water, 2 drops of pistachio flavor from sosa, 10 grams of vanilla syrup and 0.2 grams of salt
- Created the first batch of isomalt sugar rings, incorporating lime flavoring to add citrus brightness and contrast with the panna cotta.
    - 100 grams of isomalt, 10 grams trehalose, 2 drops of lime aroma and .5 g of citric acid.
- Attempted a berry foam using berry juice and lecithin to create a light, airy texture representing the Milky Way.
    - 40 grams of blackberry powder, add 200 grams of water, 1 grams of malic acid and 2 grams of lecithin

Results:

- The panna cotta gelled successfully but was slightly too firm and lacked depth in flavor.
- The isomalt rings held shape but had inconsistent textures and thicknesses.
- The berry foam was way too watery and lacked structure, very little foam formed.



First attempt at plating the dish. The foam was very liquidy, rings too thick and gel too firm.

The first week was useful for setting a good foundation. It revealed the need for better flavor balance and structural improvement in all three components. Future iterations will focus on texture control and enhanced aroma.

Week 2

Aims/objectives: Refine the taste and mouthfeel of the panna cotta sphere and improve the structure and flavor of the foam.

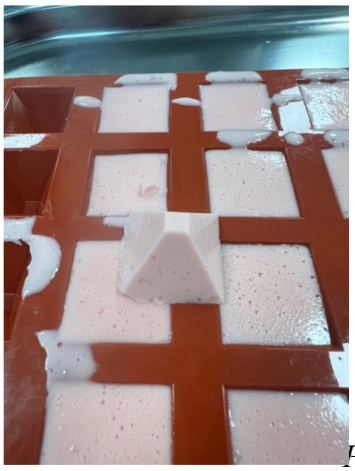
Actions Taken:

- Increased vanilla syrup in the panna cotta from 10 g to 25 g to enrich the flavor.
- Reduced agar agar from 2.5 g to 2 g to decrease firmness and create a more panna cotta-like mouthfeel.
- For the foam, added 2 g of Albuwhip to improve aeration and foam stability.
- Reduced malic acid in the foam from 1 g to 0.5 g to lower acidity and achieve a more favorable tartness.

Results:

- Panna cotta texture improved noticeably; softer and more like a traditional panna cotta while retaining its shape.
- Vanilla syrup helped balance the sweetness and complemented the coconut base.
- Foam had better structure but still dissipated too quickly.
- Acidity was more balanced, allowing berry and sweet notes to come through.


Berry foam after adding albuwhip.

 *Panna cotta has better texture, but sphere molds were unavailable.*

This week's adjustments led to improved cohesiveness between taste and texture. I need to work more on the foam stability for next week.

Week 3

Aims/objectives: Achieve a stable, aerated berry foam with improved flavor.

Actions Taken:

- Increased Albuwhip from 2 g to 15 g to significantly boost protein content and foam hold.
- Added 20 g of vanilla syrup to foam to balance tartness.
- Introduced 2 drops of passionfruit flavor to increase aromatic brightness and complexity.
- Reduced water from 240 mL to 190 mL to thicken the foam base.
- For isomalt rings, used only 1 drop of lime flavoring to reduce overpowering citrus aroma.

Results:

- Foam was significantly more stable and visually dynamic with more volume and better structure.
- Flavor was complex and layered, balancing berry, passionfruit, and vanilla. But the passionfruit was slightly overpowering.
- Isomalt rings were unsuccessful due to overcooking; texture too brittle and burnt flavor.


The foam was successful this week.


Still missing sphere molds, but texture and flavors are good.

Berry foam met expectations and was visually impressive. I need to better monitor temperature for the melting of the isomalt.

Week 4

Aims/objectives: Improve flavor harmony between components and finalize presentation. Adjust molds and aromas for better sensory experience.

Actions Taken:

- Added 10 g of coconut milk powder to the berry foam to integrate flavors and reduce sourness and remove passionfruit flavor.
- Switched to half-sphere molds to create two hemispheres that could be assembled into a whole Saturn-like sphere.
- Began visual assembly to bring together the foam, sphere, and sugar rings.

Results:

- Coconut addition to the foam helped mellow acidity and tie components together.
- Half-sphere molds better mimicked a planet.
- Visual composition was significantly improved and closely resembled the concept of Saturn and the galaxy.

This week marked a success in overall coherence, both flavor and visual themes were successfully combined. The coconut flavor served as a thread tying all elements together.


Used ladles to mold spherical gels.


Final dish.