ADVANCED MOLECULAR GASTRONOMY

TFCS9025:

NOTE-BY-NOTE COOKING DISH DEVELOPMENT REPORT of Sunset Over the Pyramids

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Course: Food Prototype Development and Evaluation – TFP9022

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1. Introduction

Molecular gastronomy is the scientific discipline that explores the physical and chemical transformations that occur during cooking, seeking to understand the “how” and “why” of culinary phenomena. For example, it examines why egg whites stiffen when whipped or how marinades tenderize meats, which the answers are rooteed in protein denaturation and enzyme activity, respectively (Fooladi and Hopia, 2013; This, 2020). Building upoon this foundation, Note by Note (NbN) cooking, developed by Hervé This, a French chemist, constructs this one step further by constructing dishes entirely from pure compounds rather than traditional whole ingredients. This approach allows chefs and food scientists to create entirely novel foods with precisely engineereed textures, structures, and flavours. For instance, imagine creating a strawberry flavour using only its constituent aroma compounds, like furaneol, rather than using actual strawberries. Achieving a recognisable flavour from such a reconstruction requires advanced sensory knowledge and careful balancing of chemical ratios. The assignment focused on applying note by note principles to design and develop a plated dessert inspired by the visual and cultural imaginary of the pyramids of Giza at a vibrant sunset. This required not only culinary skill and creativity but also a thorough understanding of the underlying food science principles to achieve desired aesthetic and sensory outcomes (Barham et. al, 2010).

This project integrates food science, sensory design, and artistic interpetation through the use of aroma molecules (e.g. vanilin for vanilla notes, ethyl butyrate for fruity notes), hdyrocolloids (e.g. agar for gelling, xantham gum for thickening). Previous studies have explored the application of gelling agents, emulsifiers, and aroma compounds in note by note cooking, which aligns closely with the goals of the Note by Note cooking. The literature surrounding molecular gastronomy emphasizes the role of precision, innovation, creativity and cross-disciplinary thinking in food design, highlighting where chefs to become scientists and artists simultaneously. For example, Spanish chef Ferran Adrià have examined the reserve-spherification technique by using calcium chloride and sodium alginate to create “Spherical Green Olives” (Adrià, 2005). By drawing inspiration from the cultural symbolism of the Egyptian pyramids and sensory palette of a desert sunset, this work transforms abstract imagery into a structured dessert using scientific techniques, effectively translating a visual experience into a multi-sensory culinary creation.

2. Aims and Objectives

Aim

To develop a visually and sensorially compelling Note by Note dessert inspired by the image of the Egyptian pyramids under a vibrant sunset, using pure compounds and molecular gastronomy techniques.

Objectives

- To apply foundational principles of Note by Note cooking by using pure compounds and food-grade chemicals to construct the dish.
- To create a colour gradient (ombre) that transitions from orange to purple, symbolizing the sun setting over the pyramids.
- To design textural components using gelling agents such as agar agar, iota carrageenan, and gellan gum to form structured gels that resemble pyramids.
- To incorporate aroma compounds to simulate fruity and citrus flavour notes in a controlled and layered manner.
- To test and iterate the dish over four weeks within a kitchen laboratory setting, adjusting variables for flavour balance, texture, and visual harmony.
- To ensure compliance with EU regulatory guidelines regarding ingredient safety and permitted levels.

3. Materials and Methods

3.1. Ingredients

Weight in grams	Ingredients	Descriptors
30 g	Patato starch 	Family elephant: fecule de pomme de terre
15 g	Wheat Gluten 	Biotiva: Weizengluten, plant-based ingredients wheat gluten

5 g	Coconut oil 	KTC: 100% pure coconut oil, odourless
3 drops each	Flavourings (Raspberry, Blueberry & Limon) 	MSK: raspberry water soluble flavour drops, blueberry oil soluble flavour drops Cocci, tropical lemon
5 g	Mora (Blackberry) Powder 	Sosa: Mora Blackberry powder
1 g	Gellan Gum 	MSK: Gellan gum F E418
3g	Lecithin 	PCB Creation: Soy lecithin
10g	Maltodextrin 	Sosa: Maltodextrin 12DE
2g	Agar agar 	Specialingredients: Agar agar vegan gelatine

3g	Orange colour 	Sosa brand orange colour
40 g	Fructose 	El Granero: Fructosa
5g	Blueberry powder 	MSK: Blueberry freeze dried powder
5g	Sodium Bicarbonate 	Gem brand baking powder
2g	Egg white powder 	Louis François Blanc Galla Powdered egg whites galia
350mL	Tap water	From the kitchen

Equipment

Amounts	**Equipments**	**Descriptors**
1x	Wisk	From kitchen laboratory
1x	Scale	Russell Hobbs small scale
1x	Small pot	From kitchen laboratory
2x	Spoons	From kitchen laboratory
2x	Stainless-steel big bowl	From kitchen laboratory

6x	White small plastic plates	From kitchen laboratory
1x	Silicone pyramid mold	From kitchen laboratory
2x	Stainless steel cake ring mold	From kitchen laboratory
1x	Stainless steel conical measuring jug	From kitchen laboratory
1x	Oven	Electrolux Skyline Premium Oven From kitchen laboratory

3.2. Methodology

Cake Preparation:

1. In a mixing bowl, combine 150mL water, 15g wheat gluten, 30g potato starch, 30g fructose, 10g maltodextrin, 5g sodium bicarbonate and 5g coconut oil. Mix until a homogenous mixture forms.
2. Add 1g xanthan gum, 5g blackberry powder and 5 g blueberry powder, 2g soy lecithin, and 2 g egg white powder to the batter. Mix thoroughly to ensure even distribution.
3. Incorporate raspberry and blueberry flavourings into the mixture.
4. Pour the mixture into a ring shaped stainless steel mold to create bottom part of the pyramids.
5. Bake at 180°C for 15 minutes or until a toothpick inserted into the center comes out clean.
6. Allow the cake to cool before demolding.

Gel Preparation:

1. In a saucepan, combine 200 mL of of tap water, orange colouring powder, and 10g fructose. Heat the mixture to while stirring.
2. Gradually add 1g gellan gum and 2g agar agar to the mixture, ensuring continuous stirring to prevent clumping.
3. Pour the hot mixture into a silicone pyramid mold to a depth of approximately 5 mm.
4. Allow the gel to set at room temperature for 30 minutes, then put the refrigerate for an additional hour.
5. Once set, demold the gel and cut the cake into shapes that complement the pyramid gel, creating an ombré effect reminiscent of a sunset.

4. Results and Discussion

Over the course of four weeks, this Note by Note cooking project aimed to conceptualise, develop, and refine a dessert inspired by the pyramids of Giza under a vibrant sunset. Through a series of iterative experiments, both the cake and gel components were progressively improved in terms of structure, flavour, and visual presentation, offering a deeper understanding of the scientific processes that underpin molecular gastronomy.

The initial formulation of the cake revealed significant shortcomings in texture and structural stability. The interior remained wet and undercooked in the center, while the surface is hard and lacked colour development, likely due to inadequate protein coagulation and starch gelatinisation. This was exacerbated by excessive water retention, influenced by the high xanthan gum content (Barham et al., 2010). Furthermore, the absence of a leavening agent resulted in a dense, compact crumb with little to no rise. According to McGee (2004), without aeration mechanisms such as steam, air incorporation, or chemical leavening, baked goods struggle to achieve desirable volume and texture.

In response, the second week introduced refinements including a reduction in water and xanthan gum, which helped prevent sogginess but introduced new challenges. The cake became structurally hollow, with a tough exterior an indication that although moisture was reduced, the mixture lacked sufficient internal lift and stability. These outcomes highlighted the importance of balancing thickening agents with functional aeration, as noted in the literature on textural engineering in modernist cuisine (This, 2020).

The final week marked a turning point with the addition of sodium bicarbonate, a chemical leavening agent. This significantly improved the cake's texture, producing a light, even crumb and eliminating previous issues of collapse and gumminess. Sodium bicarbonate acts by releasing CO_2 when exposed to heat and moisture, allowing gas bubbles to form and expand within the protein-starch matrix (Belitz, Grosch and Schieberle, 2009). Alongside this, minor adjustments in fructose and maltodextrin levels improved sweetness balance and moisture control, resulting in a more pleasant mouthfeel.

Parallel to cake development, consistent effort was directed at creating visually striking gel structures using gellan gum and agar agar. These components were highly successful in isolation, forming firm yet smooth textures and exhibiting vibrant colours. However, repeated attempts to achieve an ombré gradient between purple and orange gels faced setbacks. The

main issue was insufficient setting time between layers, which caused poor colour blending and disrupted structural integrity. This aligns with Barham et al. (2010), who note that setting kinetics are critical when constructing layered gels, and each layer must fully stabilise before additional components are added.

This process came with its own set of unique challenges. Working with pure compounds presented significant difficulties, as even minor deviations could disrupt the delicate balance of flavours. Each component had to be precisely measured and carefully controlled to achieve the intended sensory experience. Constructing both flavour and texture from individual molecules required a scientific approach, emphasizing precision, minimalism, and a deep understanding of ingredient interactions. Unlike conventional cooking, where undesired flavours can often be masked or corrected by the addition of spices, sauces, or fruit purées, Note by Note cooking offers no such flexibility. Each flavour and aroma must be measured and balanced from the start, with no room for correction. This demands an in-depth understanding of how molecules interact both chemically and sensorially.

In alignment with EU regulations, each ingredient used in this project was assessed for compliance: This was essential not only to meet food safety standards but also to ensure that all compounds used in the formulation were legally permitted and within acceptable usage limits for food-grade applications.

- **Wheat Gluten**: Recognized as a food ingredient; labelling must indicate its presence due to allergenicity.
- **Potato Starch**: Permitted as a food ingredient without specific restrictions.
- **Fructose**: Allowed as a sweetener; no specific maximum levels established.
- **Maltodextrin**: Approved as a food ingredient; no specific maximum levels established.
- **Coconut Oil**: Permitted as a food ingredient; no specific restrictions.
- **Xanthan Gum (E415)**: Authorized as a food additive under Regulation (EC) No 1333/2008; acceptable up to 1.2 g/L in specific applications.
- **Blackberry Powder**: Considered a food ingredient; no specific restrictions.
- **Soy Lecithin (E322)**: Approved as an emulsifier; must be labelled due to allergenicity.
- **Egg White Powder**: Recognized as a food ingredient; labelling must indicate its presence due to allergenicity.
- **Raspberry and Blueberry Flavourings**: Permitted under Regulation (EC) No 1334/2008; must comply with purity criteria and labelling standards.

- **Gellan Gum (E418)**: Authorized at *quantum satis* levels in most food categories.
- **Agar Agar (E406)**: Approved as a food additive; no numerical ADI established, deemed safe at typical use levels.

Overall, the four-week development cycle demonstrated how precision, creative vision, and iterative testing are essential in Note by Note cooking. The project not only refined the technical formulation of each element but also deepened the understanding of how molecular interactions—between proteins, starches, gelling agents, and flavour compounds—affect the sensory and structural outcome of a dish. While visual challenges with gel layering remain, the cake component now achieves a desirable balance of flavour, texture, and symbolic presentation, successfully embodying the project's conceptual inspiration.

5. Conclusion

This project achieved its core aim: developing a conceptually inspired Note by Note dessert using pure compounds, guided by scientific precision and creative intent. Through four weeks of iterative development, challenges with cake texture and gel layering were progressively addressed, leading to improved structure, flavour balance, and visual presentation. The work not only demonstrated compliance with EU food safety standards but also showcased the importance of molecular interaction, controlled experimentation, and continuous refinement in the field of molecular gastronomy. The cake component evolved significantly through iterative adjustments, with the introduction of sodium bicarbonate proving essential for achieving a light, stable internal texture. Simultaneously, the gel elements demonstrated strong individual integrity, though layering techniques for achieving a smooth ombré effect remain a technical challenge requiring further refinement.

Ultimately, the project deepened the understanding of molecular interactions in food design and demonstrated how scientific precision, creativity, and patience are essential to success in Note by Note gastronomy. It also reinforced the value of iterative development, ingredient compliance awareness, and structured experimentation in delivering a conceptually and scientifically sound dish.

6. Recommendations

Future work should focus on refining the ombré layering of gel components. Allowing each gel layer to fully set at room temperature before adding the next will improve structural definition and prevent unwanted blending.

While sodium bicarbonate proved effective, incorporating mechanical aeration (e.g., whipping air into the mixture) or natural acids to activate the bicarbonate more effectively could further improve internal crumb structure.

Deeper exploration into the synergistic effects between different hydrocolloids, proteins, and flavour compounds will support the development of more complex, stable, and expressive Note by Note dishes.

7. Reference

Adrià, F. (2005) *A Day at elBulli: An Insight into the Ideas, Methods and Creativity of Ferran Adrià*. London: Phaidon Press.

Barham, P., Skibsted, L.H., Bredie, W.L.P., Bom Frøst, M., Møller, P., Risbo, J., Snitkjær, P. and Mortensen, L.M. (2010) 'Molecular gastronomy: A new emerging scientific discipline', *Chemical Reviews*, 110(4), pp. 2313–2365. https://doi.org/10.1021/cr900105w

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European Commission (2008) *Regulation (EC) No 1333/2008 of the European Parliament and of the Council on food additives*. Official Journal of the European Union, L354, pp. 16–33. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008R1333 (Accessed: 7 May 2025).

European Commission (2008) *Regulation (EC) No 1334/2008 on flavourings and certain food ingredients with flavouring properties*. Official Journal of the European Union, L354,

pp. 34–50. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008R1334 (Accessed: 7 May 2025).

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McGee, H. (2004) *On Food and Cooking: The Science and Lore of the Kitchen*. Revised ed. New York: Scribner.

This, H. (2020) *Note-by-Note Cooking: The Future of Food*. Translated by M.B. DeBevoise. New York: Columbia University Press.

8. Appendices

Appendix 1. Logbook

MODULE CODE: TFCS9025

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: BUSRA OKCU

FOOD PRODUCT: Pyramid cake with gel

WEEK NO.: WEEK 1 **DATE: 18th March 2025**

Weekly Aims and Objectives

The main aim for to create an innovative, note-by-note pyramid cake as a contemporary dessert option for modern culinary settings, by using individual flavour compounds and textures, showcasing the precision and creativity of molecular gastronomy.

Objectives:

- To achieve a consistent, appealing texture in the cake by manipulating specific texture agents and structural compounds.
- To construct a balanced flavour profile that captures the essence of berries while maintaining a pleasant level of sweetness.
- To utilize NbN methods to control the colour, aroma, and overall sensory attributes of the cake for a sophisticated culinary presentation.

Materials and Method (Ingredients, Equipment and Method)

Ingredients

Weight in grams	**Ingredient**
30 g	Patato starch 

15 g	Gluten 
40 g	Coconut oil 
50 g	Glucose 
3 drops each	Flavourings (Raspberry, Blueberry & Limon) 
20 g	Mora (Blackberry) Powder 

Equipment

1x wisk
1x scale
1x small pot
2x spoons
3x ceramics bowls
3x big stainless steel bowl
6x small white plates
Eletrolux Skyline Premium Oven

Figure 1. *Tools used during the first week of note by note cooking*

Method

Preheat Oven: Set the oven to 180°C (356°F).
Mix Dry Ingredients: In a bowl, combine potato starch, gluten, and blackberry powder.
Melt Coconut Oil: Heat coconut oil until liquid and mix with glucose.
Incorporate Liquids: Add raspberry and blueberry liquids, ensuring a uniform blend.
Combine Wet and Dry: Slowly mix the wet ingredients into the dry ingredients, stirring continuously to create a smooth batter.
Adjust Consistency: If too thick, add small amounts of liquid; if too runny, adjust with more starch.
Bake: Pour the batter into a mold or form and bake for 20 minutes, or until the exterior is golden brown and firm.
Cool and Serve: Let the baked product cool before cutting and evaluating texture and taste.

Results and discussion

As seen from the photos the final baked product developed a firm, golden-brown crust, indicating proper surface cooking. However, the interior texture appeared dense, gummy, and somewhat undercooked.

Potential Causes and Improvements:

1. Dense and Chewy Texture: The mixture may have retained excess moisture, preventing a light and airy structure. Adjusting the gluten content could help improve firmness without making it too chewy. Extending the baking time or lowering the temperature slightly might allow for more even cooking.
2. Crisp Exterior vs. Undercooked Interior: The exterior baked well, suggesting that the oven temperature was high enough to form a crust, but the inside did not cook

thoroughly. Reducing the oven temperature while increasing the baking duration could promote better internal consistency or according to the our Chef Pauline increasing water content might help.

3. Flavour and Structure Adjustments: The combination of potato starch and gluten may have led to an overly chewy texture. Incorporating a leavening agent, such as baking powder, could enhance the fluffiness of the final product.

Figure 2. Picture of the final cooked cake.

Conclusions

The evaluation of the prototype revealed several areas for improvement in both texture and internal consistency. The dense and chewy texture likely stemmed from excess moisture and an imbalance in gluten and starch content, suggesting that adjusting the hydration level and gluten ratio could enhance the overall firmness. Moreover, the contrast between the crisp exterior and undercooked interior points to a need for temperature and baking time modifications—either by lowering the oven temperature and extending the duration or slightly increasing water content, as suggested by Chef Pauline. Finally, the use of potato starch and gluten may have contributed to the chewiness, indicating that integrating a leavening agent like baking powder could improve the product's fluffiness and structural balance. These insights will guide the next phase of formulation refinement, aiming for a product that offers both a pleasing texture and consistent bake.

Recommendations for following week.

Adjustment on the cake interior texture consistency is needed which will be increasing the water amount in the cake mixtur.

Ingredients required for the following 2 weeks.

Same ingredients listed below in the materials and methods.

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy
STUDENT NAME: BUSRA OKCU
FOOD PRODUCT: Pyramid cake with gel
WEEK NO.: WEEK 2 **DATE: 24th March 2025**

1. Weekly Aims and Objectives

The main aim for to create an innovative, note-by-note pyramid cake as a contemporary dessert option for modern culinary settings, by using individual flavour compounds and textures, showcasing the precision and creativity of molecular gastronomy.

Objectives:

- To achieve a consistent, appealing texture in the cake by manipulating specific texture agents and structural compounds as well as water content in the cake mixture.
- To construct a balanced flavour profile that captures the essence of berries while maintaining a pleasant level of sweetness.

2. Materials and Method (Ingredients, Equipment and Method)

a. Ingredients

Weight in grams	Ingredient
30 g	Patato starch 
15 g	Gluten 
40 g	Coconut oil 

20 g	Glucose 
3 drops each	Flavourings (Raspberry, Blueberry & Limon) 
20 g	Mora (Blackberry) Powder 
1 g	Gellan Gum 
5 g	Maltodextrin 
2 g	Agar Agar

	
30 g	Fructose 
0.5 g	Lecithin 
2 g	Xantham gum 
12 g	Egg white powder
400	Tap water

Equipment

1x wisk
1x scale
1x small pot
2x spoons
1x ceramics plate
2x big stainless steel bowl
7x small white plates
2x silicone cake moulds
Eletrolux Skyline Premium Oven

Figure 1. *Tools used during the second week of note by note cooking*

Method

Cake:

- Mix all the dry ingredients such as wheat gluten, potato starch, maltodextrin, glucose and xanthan gum in bowl.
- Melt coconut oil and mix with the dry ingredients.
- Incorporate water into the mixture little by little.
- Preheat the oven at 200 °C, baked the mixture for 20 mins.

Gel:

- Heat 100 mL water and dissolve dissolve agar agar, iota carrageenan, raspberry & blackberry flavour, blueberry powder (mora), glucose & gellan gum
- Add lecithin and blend them until smooth
- Allow the glaze to cool slightly thick

Results and discussion

During the baking process, several key physical and chemical transformations occur that determine the final texture and structure of the cake. Protein denaturation and coagulation, primarily from the egg white powder and wheat gluten, are crucial for forming a stable matrix that holds the cake's shape. When heated adequately, these proteins unfold and rebind, trapping moisture and gases to create a firm crumb. Simultaneously, starch gelatinization occurs as potato starch granules absorb water and swell at temperatures between 60–80°C, further contributing to the cake's internal structure (Kadam, Tiwari and O'Donnell, 2015). In the images given below, the cake appears sunken, with a wet and dense interior and minimal browning on the surface—indicating that these transformations were incomplete. This suggests either insufficient baking time or inadequate oven temperature. Additionally, the high water

content (150 ml) combined with 2 g of xanthan gum, a hydrocolloid known for its water-retention capacity, may have prevented excess moisture from evaporating properly, leading to a soggy texture. The absence of traditional leavening agents also likely reduced gas expansion and structure development, resulting in a collapsed form post-baking. Overall, these factors limited protein coagulation, incomplete starch gelatinization, moisture retention, and lack of leavening contributed to an undercooked and watery final product.

Figure 2. Change in cake mixture consistency by addition of water.

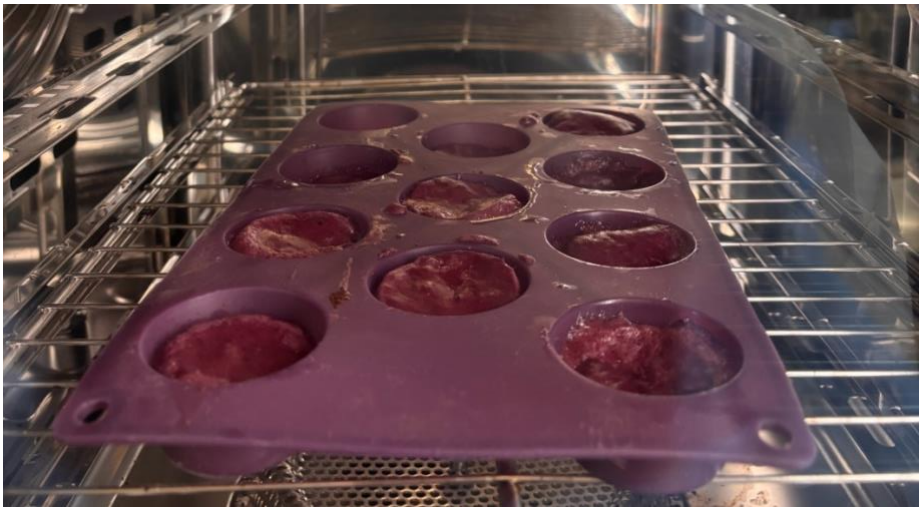

Figure 3. Picture of the final cooked cake.

Conclusions

This week's experimental work demonstrated the complexities and challenges involved in developing a Note by Note cake using pure compounds and molecular techniques. The cake exhibited signs of being undercooked, wet interior and a lack of surface browning. The outcome highlights the importance of controlling baking time, temperature, and ingredient ratios in molecular gastronomy applications.

Recommendations for following week.

Increasing baking time to ensure interior of the cake is cooked.
Reduce xanthan gum from 2 g to 1 g to prevent excessive water retention that leads to a soggy texture.
Consider reducing total water content to balance hydration with structure formation.

Reference

Kadam, S.U., Tiwari, B.K. and O'Donnell, C.P. (2015) 'Improved thermal processing for food texture modification,' in *Elsevier eBooks*, pp. 115–131. https://doi.org/10.1016/b978-1-78242-333-1.00006-1.

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy
STUDENT NAME: BUSRA OKCU
FOOD PRODUCT: Pyramid cake with gel
WEEK NO.: WEEK 3 **DATE: 31th March 2025**
Weekly Aims and Objectives

The main aim for to create an innovative, note-by-note berry cake as a contemporary dessert option for modern culinary settings, by using individual flavour compounds and textures, showcasing the precision and creativity of molecular gastronomy.

Objectives:

- To achieve a consistent, appealing texture in the berry cake by manipulating specific texture agents and structural compounds.
- To construct a balanced flavour profile that captures the essence of berries while maintaining a pleasant level of sweetness.
- To utilize NbN methods to control the colour, aroma, and overall sensory attributes of the cake for a sophisticated culinary presentation.

Materials and Method (Ingredients, Equipment and Method)

b. Ingredients

Weight in grams	**Ingredient**
30 g	Patato starch 
	Gluten

15 g	
40 g	Coconut oil 
50 g	Glucose 
3 drops each	Flavourings (Raspberry, Blueberry & Limon) 
10 g	Mora (Blackberry) Powder 
1g	Xantham gum 

Equipment

1x wisk
1x scale
1x small pot
2x spoons
3x ceramics bowls

3x big stainless steel bowl
6x small white plates
Eletrolux Skyline Premium Oven

Method

Preheat Oven: Set the oven to 180°C (356°F).
Mix Dry Ingredients: In a bowl, combine potato starch, gluten, xantham gum, and blackberry powder.
Melt Coconut Oil: Heat coconut oil until liquid and mix with glucose.
Incorporate Liquids: Add raspberry and blueberry liquids, ensuring a uniform blend.
Combine Wet and Dry: Slowly mix the wet ingredients into the dry ingredients, stirring continuously to create a smooth batter.
Adjust Consistency: If too thick, add small amounts of liquid; if too runny, adjust with more starch.
Bake: Pour the batter into a mold or form and bake for 20 minutes, or until the exterior is golden brown and firm.
Cool and Serve: Let the baked product cool before cutting and evaluating texture and taste.

Results and discussion

Following the initial challenges observed in the previous week, several modifications were made to improve the texture and structure of the cake. Specifically, the water content was reduced to limit excess moisture retention, and the xanthan gum concentration was decreased from 2 g to 1 g to prevent the overly dense exterior and liquid interior seen previously. Despite these changes, the revised cake exhibited new structural issues: while the exterior developed a firmer, almost hardened surface, the interior remained unexpectedly hollow and under-structured. This suggests that the reduction in moisture and hydrocolloid content may have contributed to inadequate internal expansion, potentially due to the lack of a leavening mechanism (Miś et al., 2016). Without a sufficient aerating agent or stabilised gas retention, steam may have created internal air pockets that collapsed during or after baking, leaving the inside hollow. Additionally, the reduced xanthan gum may have compromised the mixtures ability to trap and retain gases during baking, leading to uneven rise and internal voids.

In contrast, the gel components were successfully reproduced using the same formulation as in the previous week. The gels set well and displayed strong structural integrity. The use of blueberry powder produced a vibrant pink to purple effect, while the orange gel provided a strong visual contrast. The textural qualities of both gels were appropriate, firm but smooth. These successful elements indicate that the gelling agents (gellan gum and agar agar) performed reliably within the given parameters, and the flavour/aroma combinations

functioned as intended. Overall, while the gel components demonstrated consistency and visual appeal individually, attempts to create an ombré effect between the two colours revealed structural inconsistencies. The colours did not blend smoothly, and the interior of the gel remained partially liquid. This may be due to insufficient setting time between layers, preventing the first layer from stabilising before the second was added.

Figure 1. Dish prototype made in the third week of the project

Conclusions

This week's experiment involved recipe modifications aimed at improving the structural integrity of the cake by reducing both the water and xanthan gum content. While these changes prevented the previously observed soggy texture, the cake developed a hardened exterior and a hollow interior, indicating unresolved issues related to internal structure and gas retention. In contrast, the gel components, made using the same formulation as before, set well individually and showed strong colour and flavour expression. However, attempts to create a layered ombré effect between the purple and orange gels revealed limitations in structural layering, with colour blending issues and a partially unset interior. These results suggest that while the gelling agents were effective in isolation, timing and layering technique must be refined to achieve visual cohesion.

Recommendations for following week.

Explore the use of a food-grade leavening agent (if permitted) or mechanical aeration to support internal structure and prevent hollow cavities in the cake.

Allow each gel layer to fully set before adding the next to prevent blending and maintain visual separation for a clean ombré effect.

Ingredients required for the following 2 weeks.

Sodium bicarbonate or baking powder

Reference

Miś, Antoni, Nawrocka, Agnieszka, Dziki, Dariusz, 2016. Identification of Baking Expansion Phases of Leavened Dough Using an Experimental Approach. Food and Bioprocess

Technology, 9(5), pp.892-903. Available at: https://doi.org/10.1007/s11947-015-1669-7 [Accessed April 2, 2025].

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy
STUDENT NAME: BUSRA OKCU
FOOD PRODUCT: Pyramid cake with gel
WEEK NO.: WEEK 4 **DATE: 7th April 2025**
Weekly Aims and Objectives

The main aim for to create an innovative, note-by-note berry cake as a contemporary dessert option for modern culinary settings, by using individual flavour compounds and textures, showcasing the precision and creativity of molecular gastronomy.

Objectives:

- To achieve a consistent, appealing texture in the berry cake by manipulating specific texture agents and structural compounds.
- To construct a balanced flavour profile that captures the essence of berries while maintaining a pleasant level of sweetness.
- To utilize NbN methods to control the colour, aroma, and overall sensory attributes of the cake for a sophisticated culinary presentation.

Materials and Method (Ingredients, Equipment and Method)
Ingredients

Weight in grams	**Ingredient**
30 g	Patato starch 
15 g	Gluten 
40 g	Coconut oil 
	Fructose

50 g	
3 drops each	Flavourings (Raspberry, Blueberry & Limon) 
20 g	Mora (Blackberry) Powder 

Equipment

1x wisk
1x scale
1x small pot/saucepan
2x spoons
1x pyramid shaped silicone mold
2x stainless steel conical measuring jug
3x Stainless steel cake ring mold
1x small oven tray
1x big stainless steel bowl
1x small stainless steel bowl
6x small white plates
Eletrolux Skyline Premium Oven

Figure 1. Equipments used in the last week of the project.

Method

Cake Preparation:

7. In a mixing bowl, combine 150mL water, 15g wheat gluten, 30g potato starch, 30g fructose, 10g maltodextrin, 5g sodium bicarbonate and 5g coconut oil. Mix until a homogenous mixture forms.
8. Add 1g xanthan gum, 5g blackberry powder and 5 g blueberry powder, 2g soy lecithin, and 2 g egg white powder to the batter. Mix thoroughly to ensure even distribution.
9. Incorporate raspberry and blueberry flavourings into the mixture.
10. Pour the mixture into a ring shaped stainless steel mold to create bottom part of the pyramids.
11. Bake at 180°C for 15 minutes or until a toothpick inserted into the center comes out clean.
12. Allow the cake to cool before demolding.

Gel Preparation:

6. In a saucepan, combine 200 mL of of tap water, orange colouring powder, and 10g fructose. Heat the mixture to while stirring.
7. Gradually add 1g gellan gum and 2g agar agar to the mixture, ensuring continuous stirring to prevent clumping.
8. Pour the hot mixture into a silicone pyramid mold to a depth of approximately 5 mm.
9. Allow the gel to set at room temperature for 30 minutes, then put the refrigerate for an additional hour.
10. Once set, demold the gel and cut the cake into shapes that complement the pyramid gel, creating an ombré effect reminiscent of a sunset.

Results and discussion

In this week's experiment, addition of the leavining agent, sodium bicarbonate, to the cake formulation significantly improved the internal structure and texture of the final product. Compared to previous attempts, the cake showed a more aerated and uniform crumb, with a less dense and more stable structure. This improvement is attributable to the leavening action of sodium bicarbonate**,** which reacts with acidic and thermal components during baking to release carbon dioxide gas, thus expanding and lightening the cake mixture (McGee, 2004). Additionally, balancing other ingredient ratios such as reducing fructose and adjusting maltodextrin helped regulate moisture content and batter consistency. These changes allowed for better protein network formation (from wheat gluten and egg white powder) and starch gelatinization, contributing to a firmer and more cohesive baked product.

The gel component, made using agar agar and gellan gum, successfully replicated the visual aesthetic of a sunset through the use of orange coloring. However, attempts to create an ombré effect with two gel colors were again unsuccessful, mirroring the difficulties encountered in the previous week. The failure of the colour gradient to blend smoothly, and the observation that the interior of one layer remained unset, likely stem from insufficient setting time between layers**.** As gelling agents like agar and gellan require time to fully stabilize at room temperature and then in refrigeration, pouring a second hot layer before the first has fully gelled disrupts the structural integrity and causes internal phase separation (Barham et al., 2010).

While the individual elements of the dish—both cake and gel—showed progress, integration of the two into a seamless, visually layered dessert remains a technical challenge. Nonetheless, final week's outcome demonstrates how targeted ingredient changes**,** particularly the inclusion of a chemical leavening agent, can result in substantial improvements in texture and structural performance within Note by Note cooking.

Figure 3. Final dish of the Note by Note cooking "Sunset over the Pyramids".

Conclusions

This week's experiment demonstrated measurable progress in the structure of the Note by Note dessert. The incorporation of sodium bicarbonate as a chemical leavening agent notably enhanced the cake's internal texture, yielding a more aerated, resolving previous issues of hollowness and surface hardening. Additionally, adjustments to ingredient ratios contributed to improved moisture control and stability. While the individual gel components retained their strong visual and textural properties, repeated attempts to achieve a smooth ombré transition between colors remained unsuccessful, primarily due to premature layering before full gelation. These findings underscore the critical role of precise timing and temperature control in multi-phase gel construction. Overall, the experiment highlights the importance of small, targeted ingredient modifications and reinforces the need for further refinement in visual integration techniques.

Reference

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