OLLSCOIL TEICNEOLAÍOCHTA
BHAILE ÁTHA CLIATH
TECHNOLOGICAL
UNIVERSITY DUBLIN

Note by Note Cooking: Deconstructed Berry Cheesecake

Laura Moraes Machado

08/05/2023

Pauline Danaher & Róisín Burke

Table of Contents

Introduction

Among many variables and potential outcomes, a remarkable dichotomy characterizes our food system. On the one hand, an estimated 820 million individuals suffered from food insecurity in 2019 (FAO, 2019). On the other hand, a staggering 88 million tonnes of food is recklessly discarded in the European Union on an annual basis (Scherhaufer, *et al.,* 2018), and the Environmental Protection Agency has reported that Ireland alone wasted a substantial 770,300 tonnes of food in 2020.

Throughout the food supply chain, from farm to table, food waste is an omnipresent issue. Households and the manufacturing/processing sector are the primary contributors to this problem. Common reasons for food waste include misinterpreting the "best before" date, purchasing excess groceries, and the production of unsuitable food or process waste in food manufacturing (EPA, 2022)

One example of how waste happens during food manufacturing is the dairy industry. A major player in the food sector globally, it contributes significantly to environmental damage, such as greenhouse gas emissions, water waste, and whey waste. Whey protein, a protein-rich byproduct of cheese production, is generated in large quantities as Europe is one of the world's largest cheese producers, with France alone exporting roughly 33% of its production (Fernández-Gutiérrez *et al.,* 2017; Panghal, *et al.,* 2018).

Additionally, the fruit category, particularly berries like blackberries, raspberries, and strawberries, are highly perishable and require careful handling. (Kumar *et al.,* 2018, Einbond, *et al.,* 2004). Although berries are considered one of the healthiest nutrient sources, their shelf-life is extremely short, due to a high water activity and fragile structure that increase the risk for microbial spoilage (Meyer-Concha *et al.,* 2015).

The module Advanced Molecular Gastronomy focuses on one of the most relevant topics regarding sustainability: food waste. By utilizing cutting-edge technology and culinary techniques, Note by Note (NBN) Cooking applies its principals to produce innovative dishes with a forward-thinking approach to food production and waste reduction. At its core, NBN Cooking involves the creation

of culinary dishes from pure compounds instead of traditional ingredients, resulting in unique and captivating sensory experiences that challenge traditional notions of food and redefine the way we enjoy it.

Furthermore, the module invites students to use science as a foundation to develop innovative dishes that boost creativity and encourage thinking outside the box. Students are given autonomy to experiment with unique sensorial-influencing compounds, resulting in a wide variety of textures, flavors, and aromas.

This report describes the development of a deconstructed Note by Note cheesecake with the aim of addressing two issues: first, the significant amount of whey waste produced by the dairy industry, and second, the challenge of incorporating highly perishable berries into desserts without risking spoilage. To tackle these issues, the project utilized NBN compounds and techniques to create a sustainable and innovative approach to cheesecake production.

Aims and objectives

The primary aim of this project is to develop a deconstructed cheesecake using Note-by-Note techniques, incorporating blackberry spheres and a crust crumble. The purpose is to address two key challenges in the food industry: waste reduction and sustainability. To achieve this, the report explores the use of milk proteins such as whey protein, micellar casein, and milk powder as a substitute for cream cheese, thereby targeting a reduction whey waste during its production. Additionally, the project aims to offer a sustainable solution for using blackberries, a highly perishable fruit, in desserts. By using reverse spherification to create blackberry spheres and developing a Note-by-Note crumble using pure compounds, the final goal is to create an appealing and flavorful dessert that offers a sustainable solution for reducing waste and utilizing perishable ingredients.

Objectives

- Research and combine different molecular gastronomy techniques to produce textures that complement each other in final dish.
- Explore methods to incorporate berries and increase their shelf-life.
- Incorporate blackberries by using blackberry powder, water, and sucrose through reverse spherification method.
- Test and adjust the flavors of the blackberry spheres to achieve a balance of sweet and slightly sour taste.
- Incorporate cheesecake crust by creation of a note-by-note crumble using two different formulations.
- Create a note-by-note cheesecake formulation using milk proteins such as whey protein, micellar casein, milk powder and water to replace cream cheese.
- Plate the dish in a visually appealing manner that highlights the unique elements of the dessert.
- Evaluate the overall sustainability of the dish.

Materials and Methods

Presented in the table below is the final ingredient and equipment list to create the final fish: berry cheesecake.

Table 1. Ingredient list per element.

Cheesecake			
Yield: 6 mini cheesecakes (7x3,5cm)			
Ingredient	**Quantity g**	**Quantity %**	**Supplier**
Micellar casein	25g	7,5	Sports Supplements Limited t/a Bulk™
Whey protein	5g	1,5	Sports Supplements Limited t/a Bulk™
Skimmed milk powder	10g	3	Lakeland Dairies
Sucrose	40g	12	N/A
Iota carrageenan	2g	0,6	MSK
Lecithin	0,5g	0,1	SOSA
Water	250g	74,7	N/A
“Vanilla” flavor	1g	0,3	Euro Vanille
Lactic acid	1g	0,3	Essedielle
Blackberry Spheres			
Water bath			
Sodium alginate	2,5g	0,5	SOSA
Water	500g	98,5	N/A
Sucrose	5g	1	N/A
Blackberry solution			
Water	240g	86	N/A
Blackberry powder	10g	3,6	SOSA
Whey protein	1,5g	0,5	Sports Supplements Limited t/a Bulk™
Sucrose	20g	7,2	N/A
Xanthan gum	2,5g	0,9	SOSA
Calcium Lactate	10g	1,8	MSK
Crumble			
Used in plating: 10g			
Maltodextrin	25g	41,7	SOSA
Corn starch	10g	16,7	Gem
Cacao Butter	10g	16,7	Callebaut
Sucrose	10g	16,7	N/A
Water	5g	8,3	N/A

Table 2. Equipment list.

Equipment	Quantity	Model
Medium bowl	3	Steel
Small bowl	1	Steel
Balloon whisk (small)	2	N/A
Tablespoon	2	N/A
Plastic plates	5	N/A
Silicon spatula	1	N/A
Weighing scales	1	N/A
Measuring jug	1	1L, steel
Mold	1	Silicon 6 holes 7x3,5cm
Baking tray	1	Carbon non-stick
Parchment paper	Enough for tray	N/A
Small pot	1	Stainless steel
Medium pot	1	Stainless Steel
Anti-stick spray	1	-
Thermo-mix	1	TM31
Stove	1	Electrolux Modular Cooking Range Line 2-Burner
Oven	1	Electrolux Skyline Premium
Syringe	1	Plastic, 5ml
Perforated spoon	1	Stainless Steel
Vacuum bag	1	Plastic bag
Vacuum Machine	1	La Minerva

Process

Cheesecake

1. Using a weighing scale, measure micellar casein, whey protein, sugar, milk powder, iota carrageenan and lecithin.
2. Measure water using the measuring jug.
3. In a medium bowl, mix the micellar casein, whey protein, sugar, milk powder, iota carrageenan, lecithin, and water with a whisk until smooth.
4. Heat the mixture over medium heat, stirring constantly, until it comes to a simmer.
5. Reduce heat to low and stir for 2-5 minutes to thicken.
6. Remove from heat and add the lactic acid and vanilla flavor, stirring well to combine.
7. Spray silicon mold with non-stick spray and pour the mixture.
8. Let it set in ambient temperature for 2 hours or in the fridge for 40 minutes.
9. Once it has set, remove it from the mold and plate.

Blackberry spheres

1. Using a thermomix, blend sodium alginate, water, and sugar at speed 7 for 2 minutes.
2. Pour mixture into a medium bowl and reserve.
3. Mix blackberry powder, water, sugar, calcium lactate and xanthan gum in a medium bowl with a whisk. Pour mixture into a plastic bag and put in the vacuum machine to remove excess air.
4. Using a syringe, drop blackberry solution into the alginate bath.
5. Wait 2 minutes and remove using a perforated spoon.
6. Rinse in a bath of water.
7. Remove excess water and serve.

Crumble

1. Pour water on a small pan and bring to a boil.
2. Weigh cacao butter in a small bowl and put on top of pan in a bain-marie until melted (3 minutes).

3. In a medium bowl, weigh and combine maltodextrin, corn starch and sugar.
4. Add the melted cacao butter and mix.
5. Gradually add in water until it reaches a crumbly texture.
6. Spread the crumble on a baking tray lined with parchment paper.
7. Bake at 200°C for 10-15 minutes or until golden.

Results

Cheesecake

For the final dish, whey protein concentrate, micellar casein, sugar, and milk powder were used in combination with texturizing agents such as iota carrageenan and lecithin, along with vanilla and lactic acid to mimic the appearance and flavor of a traditional cheesecake. The resulting cheesecake has a pleasant, sweet vanilla flavor. It had a creamy and gelatinous texture as expected when using iota carrageenan. However, the color could be improved, as it was too white. Adding a small amount of yellow coloring could provide the traditional peachy/yellow color of baked cheesecakes, avoiding a "flan" like appearance.

The dish is accompanied by blackberry spheres, which provide a sweet and slightly sour flavor that is characteristic of berries. The spheres add a burst of flavor and texture. The crumble on top of the cheesecake adds crunchiness that complements the smooth and creamy textures of the other components. Together, these elements create a balanced and enjoyable dessert.

Figure 1 and 2. *Final NBN dish.*

Blackberry spheres

During the preparation of blackberry spheres, the initial results were not as expected as the spheres were disintegrating when removed from the alginate solution. To solve this issue, the recipe required the addition of extra 5g of calcium lactate (originally, it was only 5g) and 2.5g of xanthan gum. This addition not only helped in stabilizing the solution but also improved its texture.

Xanthan gum was required to thicken and stabilize the blackberry juice, creating a more viscous texture that made the solution easier to handle during the spherification process. The addition of extra calcium lactate also played an important role in the overall success of the recipe. The initial spheres were too fragile and easily broke apart when removed from the alginate solution. With the addition of calcium lactate, the texture and stability of the gel were improved, resulting in a more durable sphere.

***Figure 3**. Blackberry solution made with blackberry powder, sugar, water, calcium lactate and xanthan gum.*

***Figure 4**. Blackberry spheres inside sodium alginate bath.*

.

Crumble

A golden, crunchy, sweet crumble was obtained by the mixture of corn starch, maltodextrin, cocoa butter, sucrose, and water. The addition of maltodextrin in the recipe did not achieve the desired caramelization effect as sucrose did. As a result, white particles were still visible, which gave it a texture similar to that of cornflakes. The mouthfeel of the crumble was harsher than expected, however, the flavor was appropriate. In combination with the velvety and jelly burst textures of the cheesecake and blackberry spheres, it brought an interesting crunchiness to the dish.

Figure 5. *Crumble after baking.*

Discussion

The history of cheesecake dates to ancient Greece, and today it is a popular dessert enjoyed worldwide. Typically, cream cheese serves as the base ingredient, produced through acidification of pH and whey discard. Commonly, it is accompanied by fruit toppings such as jam and fresh fruit. However, in an effort to reduce waste in the production of cream cheese and incorporate berries in a way to prevent spoilage and create a more sustainable recipe, a Note-by-Note cheesecake was created.

This innovative version incorporates whey protein and berries, not only adding nutritional value but also reducing the environmental impact of food waste. The dish was composed by a dome made of cheesecake, a crumble and blackberry spheres. Whey protein was incorporated both in the cheesecake itself and in blackberry spheres.

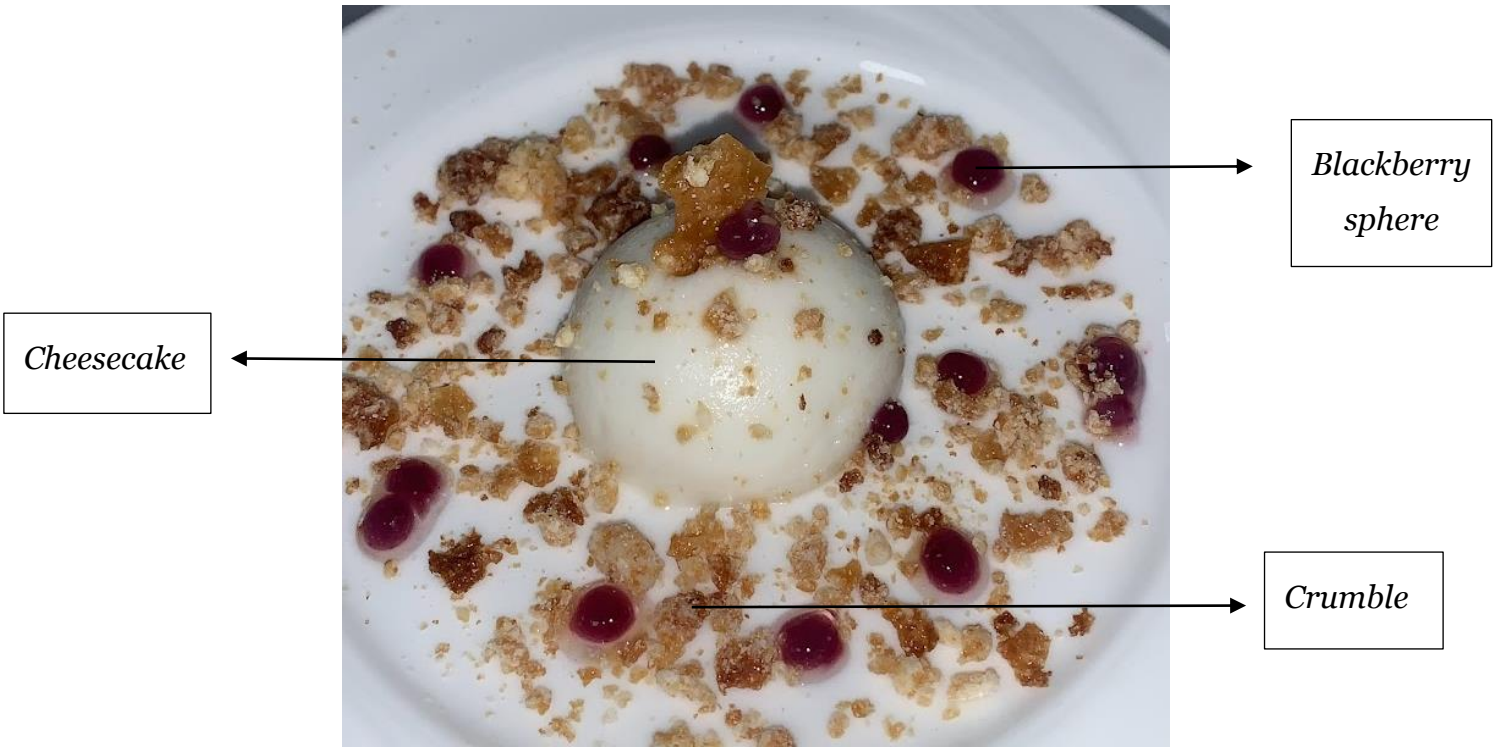

Figure 6. *Final dish.*

Cheesecake

The first attempt at creating a NBN cheesecake was made with the mixing of milk powder and water with the aim of producing NBN cream cheese to be used as a base. However, after a few trials, this hypothesis failed: as skimmed powdered milk was used, there was not enough fat to create the curd. Furthermore, a huge amount of skimmed milk would be necessary to produce enough cream cheese to continue the tests. Another trial of creating cream cheese involved the traditional method of mixing fresh milk and vinegar to form cheese curds. Both options were not sustainable and contradicted the theme of the project as the first would require a huge amount of milk powder and the second produced a lot of whey waste. More information about these tests can be found in Annex 3.

Research for no-bake and/or vegan cheesecakes led to the conclusion that gelling agents are often used to mimic the texture of the traditional dessert. Iota carrageenan was the most suitable option: a polysaccharide from seaweeds that requires a temperature higher than 70°C to produce thermoreversible, soft, and elastic gels through ionic interaction. It starts to set as temperature goes down from 70°C to 40°C, forming helix structures with the heat and aggregating once temperature cools down. In contrast, the Kappa type produces firm and brittle gels, and the texture would not be like the one of traditional cheesecakes. (Lersch, 2014).

Micellar casein, whey protein, milk powder, and water were used to provide a colloidal suspension of proteins, fat and moisture that would have been provided by cream cheese.

The milk proteins play an important role on gelation: whey molecules are heat sensitive. As the mixture was taken to boil to activate the iota carrageenan, there is a breakage of disulphide bonds which allow them to create bonds within each other. Iota carrageenan suffers from influence of milk proteins: when setting, gelation happens at a higher temperature in skim milk because of the interaction between molecules. (Bosc, Véronique. 2022, APT).

Whey protein is a high biological value protein, superior to soy protein and even beef, as it contains all 20 amino acids and is rich in calcium and magnesium.

During cheese production, water-soluble vitamins are transferred into the liquid, including Vitamin B12, which is a common deficiency in Ireland and worldwide (Laird, *et al.,* 2018). While whey can be used as a functional ingredient in the food industry and as a nutritional supplement, it is still the most polluting substance from cheese production and a significant amount of it is released as wastewater containing a high organic load. (Fernandez-Gutierrez *et al.,* 2017; Panghal *et al.,* 2018). In this dish, whey protein was incorporated into the cheesecake and in the blackberry spheres.

Lecithin, a substance composed mainly by phospholipids, is an important emulsifier and is used in this formula to create a uniform O/W emulsion through its apolar tail and polar head when incorporating all ingredients together. Lecithin can also be used also as a wetting agent, to reduce viscosity and control crystallization (List, 2015).

One of the observations about the final dish is that its texture was more similar to that of a flan than a cheesecake. To address this issue, one option is adding a fat source such as coconut oil or cocoa butter to provide a creamier texture and improve its mouthfeel. Changing the ratio of milk proteins by increasing the quantity of micellar casein can also have a positive outcome in regards to creaminess, as it can have a synergetic effect when paired with carrageenan (especially Kappa: Flett *et al.* 2010). Changing the type and concentration of carrageenan can also be an option for further tests.

Regarding flavor, natural vanilla was added as it is a common flavoring used in cheesecake recipes as well as lactic acid. Lactic acid was used to provide the slightly sour and acidic flavor characteristic of dairy products and cheesecakes. Ideally, it would be interesting to include cheesecake flavoring for an authentic taste.

Blackberry spheres

Berries are an important source of antioxidants and low in calories, containing phytochemicals like phenolic compounds and vitamins. One such antioxidant is anthocyanin, responsible for the vibrant red, blue, or purple hues in berries, that effectively prevents oxidative stress and helps prevent some of the leading causes of mortality today, such as cancer, diabetes, and cardiovascular

diseases (Wang & Stoner, 2008; Baby *et al.* 2017). Unfortunately, the shelf-life of berries is short, and a lot of waste is generated post-harvest (Kumar *et al.*, 2018)

Blackberries are an important source of anthocyanins and other flavonoids, with similar health effects, and these compounds can be extracted to be used in functional foods to increase their nutrition profile. (Skrovankova *et al.,* 2015).

Blackberry juice was created using blackberry powder, sugar, water, calcium lactate and xanthan gum. Xanthan gum was added to increase the thickness of the solution and calcium lactate was incorporated to create spheres through the reverse spherification method: using a syringe, the liquid containing calcium lactate was transferred to a bath composed by a solution of sodium alginate, water, and sugar. Calcium lactate encapsulated the blackberry juice by creating a hydrocolloid membrane. Spheres were further bathed in cold water and were ready to plate. The reverse spherification method was chosen for the spheres produced aren't as fragile when compared to the basic method and can last longer (Burke *et al.,* 2021).

The addition of xanthan gum and calcium lactate altered the texture of the solution, making it slightly more difficult to expel from the syringe during the spherification process. However, it was this thickening effect that made the spherification process possible, resulting in the creation of visually appealing blackberry spheres.

Crumble

During the creation of the deconstructed Note by Note cheesecake, a final crumble was developed with inspiration from a traditional recipe that typically uses flour, butter, and sugar. In this case, corn flour, cocoa butter, and maltodextrin were used instead, along with a small amount of water to improve texture.

While class nº 2 involved testing a similar element using the bacon soil recipe found in the Handbook of Molecular Gastronomy, the taste was deemed unpleasant, prompting the decision to experiment with a traditional crumble for improved flavor. Despite this change, it was noted during the plating of the final

dish that the appearance of the pink crumble would have been more visually appealing.

The texture of the crumble was rougher than what was expected, which made it difficult to break through the conglomerates. This could be attributed to the higher quantity of maltodextrin used, which may have caused the mixture to become too thick. Alternatively, it may be worth considering the use of different cooking techniques to help improve the overall texture of the crumble, such as longer cooking times at lower temperatures, exclusive use of sucrose instead of maltodextrin or a mixture of different starches instead of using only corn.

Conclusions and Recommendations

The process of developing a Note-by-Note dish was, while challenging, an interesting experience. The practical applications of this Molecular Gastronomy branch are infinite and allows the creation of dishes overflowing with creativity.

The dish achieved its sustainability goals by incorporating whey, a byproduct responsible for waste in the dairy industry, into a dessert where cream cheese is commonly used as a base. Additionally, blackberries, a highly perishable fruit, were utilized in the form of spheres to enhance both the flavor and texture of the dish. While visual considerations could be improved, the dessert met its sustainability objectives.

In retrospect, upon reviewing the final dish, it becomes apparent that there is ample room for improvement, particularly in terms of its appearance. Better time management would have helped me plate it in a more composed manner (check Annex 5 for comments). It was intended to be a visually appealing dessert, and perhaps incorporating the pink crumble from week 2 would have enhanced the overall presentation. Additionally, a slight cream color could make an impact in the visual aspect for future formulations.

The journey of exploring Molecular Gastronomy and the creation of Note-by-Note dishes can be challenging, requiring patience and perseverance. Throughout the process, mistakes and setbacks are inevitable, but they can also be valuable learning experiences. I learned that it is okay to be wrong and we should not be afraid to get out of our comfort zone to try again. In fact, the trial-and-error process can reveal unexpected sources of knowledge. These lessons led to a greater understanding of the science behind food and the art of cooking.

The experience of creating a NBN dish and carrying out some of the techniques myself was a fascinating opportunity to get a glimpse into the limitless possibilities of NBN cooking. While there is always room for improvement, I could apply what I learned during the first semester of FIPDEs into my dish, and the journey itself was a valuable lesson on both science and gastronomy.

References

Food and Agriculture Organization. 2019. The state of food insecurity in the world. Safeguarding against economic slowdowns and downturns. Rome: Food and Agriculture Organization of the United Nations.

Scherhaufer, S., Moates, G., Hartikainen, H., Waldron, K., Obersteiner, G., 2018. Environmental impacts of food waste in Europe. Waste Management 77, 98–113. https://doi.org/10.1016/j.wasman.2018.04.038

Environmental Protection Agency. 2022 Food Waste Statistics for Ireland. Retrieved from < https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/food/>

Fernández-Gutiérrez, D., Veillette, M., Giroir-Fendler, A., Ramirez, A.A., Faucheux, N., Heitz, M., 2017. Biovalorization of saccharides derived from industrial wastes such as whey: a review. Rev Environ Sci Biotechnol 16, 147–174. https://doi.org/10.1007/s11157-016-9417-7

Panghal, A., Patidar, R., Jaglan, S., Chhikara, N., Khatkar, S.K., Gat, Y., Sindhu, N., 2018. Whey valorization: current options and future scenario – a critical review. NFS 48, 520–535. https://doi.org/10.1108/NFS-01-2018-0017

Laird, E.J., O'Halloran, A.M., Carey, D., O'Connor, D., Kenny, R.A., Molloy, A.M., 2018. Voluntary fortification is ineffective to maintain the vitamin B 12 and folate status of older Irish adults: evidence from the Irish Longitudinal Study on Ageing (TILDA). Br J Nutr 120, 111–120. https://doi.org/10.1017/S0007114518001356

Kumar, S., Baghel, M., Yadav, A., Dhakar, M.K., 2018. Postharvest Biology and Technology of Berries, in: Mir, S.A., Shah, M.A., Mir, M.M. (Eds.), Postharvest Biology and Technology of Temperate Fruits. Springer International Publishing, Cham, pp. 349–370. https://doi.org/10.1007/978-3-319-76843-4_15

Einbond, L.S., Reynertson, K.A., Luo, X.-D., Basile, M.J., Kennelly, E.J., 2004. Anthocyanin antioxidants from edible fruits. Food Chemistry 84, 23–28. https://doi.org/10.1016/S0308-8146(03)00162-6

Skrovankova, S., Sumczynski, D., Mlcek, J., Jurikova, T., Sochor, J., 2015. Bioactive Compounds and Antioxidant Activity in Different Types of Berries. IJMS 16, 24673–24706. https://doi.org/10.3390/ijms161024673

Wang, L.-S., Stoner, G.D., 2008. Anthocyanins and their role in cancer prevention. Cancer Letters 269, 281–290. https://doi.org/10.1016/j.canlet.2008.05.020

Baby, B., Antony, P., Vijayan, R., 2018. Antioxidant and anticancer properties of berries. Critical Reviews in Food Science and Nutrition 58, 2491–2507. https://doi.org/10.1080/10408398.2017.1329198

Concha-Meyer, A., Eifert, J.D., Williams, R.C., Marcy, J.E., Welbaum, G.E., 2015. Shelf Life Determination of Fresh Blueberries (Vaccinium corymbosum) Stored under Controlled Atmosphere and Ozone. International Journal of Food Science 2015, 1–9. https://doi.org/10.1155/2015/164143

List, G.R., 2015. Soybean Lecithin: Food, Industrial Uses, and Other Applications, in: Polar Lipids. Elsevier, pp. 1–33. https://doi.org/10.1016/B978-1-63067-044-3.50005-4

Burke, R., Kelly, A., Lavelle, C. & This Vo. Kientza, H. 2021. Handbook of Molecular Gastronomy: Scientific Foundations, Educational Practices, and Culinary Applications. Handbook of Molecular Gastronomy: Scientific Foundations, Educational (routledge.com) CRC Press. (June 9th 2021).

Burke, R. and Danaher, P. (2018). Project-based Learning and Note by Note Cooking: Two Ingredients to Enhance Student Learning and Creativity. Poster Presentation, ISEKI conference, Stuttgart, 3-5 July, University of Hohenheim.

Burke, R.M., Danaher, P. & Hurley, D. Creating bespoke note by note dishes and drinks inspired by traditional foods. J. Ethn. Food 7, 33 (2020). https://doi.org/10.1186/s42779-020-00071-3

Lersch, M. (ed.) Texture - A hydrocolloid recipe collection (v.3.0, 2014). Available for free download from http://blog.khymos.org/recipe-collection/

Flett, K.L., Duizer, L.M., Goff, H.D., 2010. Perceived Creaminess and Viscosity of Aggregated Particles of Casein Micelles and κ-Carrageenan. Journal of Food Science 75, S255–S262. https://doi.org/10.1111/j.1750-3841.2010.01635.x

ANNEXES

1-5

Annex 1: Logbook 1

MODULE TITLE: *Advanced Molecular Gastronomy*

STUDENT NAME: *Laura Moraes Machado*

Note by Note Cooking, class 1

DATE: 20/03/2023

1. Aims and Objectives

1.1. Aim: To develop a dish that provides a sustainable way to incorporate berries in dessert recipes.

1.2. Objectives:

- Test reverse spherification method for blackberry flavor.
- Test blackberry juice substitution using 10g of blackberry powder, 15g of sugar and 240ml of water.
- Evaluate if addition of xanthan gum is necessary to thicken juice solution.
- Evaluate overall flavor of spheres.
- Evaluate overall texture of the spheres.

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

2.1. Materials

Blackberry pearls/spheres		
Water bath:	**Quantity in grams**	**Quantity in %**
Sodium alginate	2.5g	0,5
Water	500g	98,5
Sugar	5g	1
Total	507,5g	100
Blackberry Juice:	-	
Water	240g	87,9
Blackberry powder	10g	3,7
Sugar	15g	5,5
Calcium lactate	5g	1,8
Xanthan gum	3g	1,1
Total	273	100

Equipment	
Medium bowl	3
Perforated spoon	1
Weighing scale	1
Spoon	1
Robot Coupe R2	1
Stove (Electrolux Cooking Range 2 Burner)	1
Syringe	1
Vacuum bag	1
Vacuum Machine La Minerva	1
Medium whisk	1

2.2. Method

2.2.1. Blackberry Spheres

1. Prepare alginate bath mixing sodium alginate with water and sugar in the Robot Coupe for 2 minutes.
2. Mix blackberry juice ingredients using a whisk.
3. Remove excess air by placing it in a vacuum bag in the vacuum machine.
4. Using a syringe, drop the blackberry juice into the alginate bath.
5. If spheres are too fragile, add xanthan gum to thicken the solution.
6. Wait 2 minutes and remove using the perforated spoon.
7. Rinse in a bath of water. Remove and serve.

3. Results and discussion

Spheres were prepared using the reverse spherification method: 5g of calcium lactate was added to the blackberry juice made using 10g of blackberry powder, 15g of sugar and 240g of water. 3g of xanthan gum was mixed to the juice using a hand mixer so that the recipe could be followed as described above.

The added xanthan gum increased the thickness of the solution making it difficult to expel the liquid from the syringe. For that reason, it was hard to keep a pattern in circular shapes when exposed to the sodium alginate bath. The texture of the spheres was smooth as ingredients were well mixed. The flavor of the spheres was of strong blackberry but lacked sweetness.

Figure 1. *Blackberry sphere.*

4. Conclusion and Recommendations

After addition of xanthan gum, the solution became slightly too thick, difficult to expel from the syringe. However, the texture of the spheres was appropriate, keeping its integrity even in my hand (Figure 1). When preparing the blackberry juice, the amount of sugar was not enough. For the following weeks, increase the quantity of sugar for 30g and do not add xanthan gum.

5. References

Material from Molecular Gastronomy Module on Alginate and Agar.

Annex 2: Logbook 2

MODULE TITLE: *Advanced Molecular Gastronomy*
STUDENT NAME: *Laura Moraes Machado*
Note by Note Cooking, class 2

DATE: 27/03/2023

1. Aims and Objectives

1.1. Aim: To develop a dish that provides a more sustainable way to incorporate berries in recipes, extending its shelf-life with interesting textures.

1.2. Objectives:

- Test white chocolate crumble coloring: 2g liquid red colorant; 2g powdered red colorant.
- Test white chocolate crumble texture by addition of maltodextrin.
- Test blackberry spheres with no xantham gum.
- Test blackberry spheres with addition of 15g of sugar (30g total).
- Test blackberry spheres with addition of champagne flavor.

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

2.1. Materials

White chocolate crumble		
Ingredients	**Quantity in g**	**Quantity in %**
Cocoa butter	25	57,5
Olive oil	14	32,2
Red coloring	1g	2,3
White chocolate aroma	2g	4,6
Raspberry flavor	1g	2,3
Soy lecithin	0,5	1,1
Maltodextrin	40	92,0
Total	43,5	100%
Blackberry pearls		
Water bath:		
Sodium alginate	2.5g	0,5
Water	500g	98,5
Sugar	5g	1,0
Blackberry Juice:	-	100%
Water	240g	83,9
Blackberry powder	10g	3,5
Sugar	30g	10,5

Calcium lactate	5g	1,7
Champagne flavor	3 drops	0,3

Equipment	
Steel bowl	5
Silicon spatula	1
Small pan	1
Weighing scale	1
Spoon	3
Vorwerk Thermomix TM31	1
Stove (Electrolux Cooking Range 2 burner)	1
Syringe	1
Vacuum bag	1
Vacuum Machine La Minerva	1

2.2. Method

Blackberry Spheres

1. Blend ingredients sodium alginate, water, and sugar in the Thermomix for 2 minutes at speed 5.
2. Mix blackberry powder, water, sugar, champagne flavor, and calcium lactate and remove excess air with the vacuum machine.
3. Using a syringe, drop the blackberry juice into the alginate bath.
4. Wait 2 minutes and remove.
5. Rinse in a bath of water. Remove and serve.

White chocolate crumble

1. Weigh out all ingredients, keeping maltodextrin separate.
2. Place the fats into a medium metal bowl and melt over a bain-marie.
3. Once melted, add the colours and flavours to the fats, and add 2 g of soy lecithin.
4. Blend in a Thermomix at speed 7 for 2 minutes to emulsify the colours and fats.
5. Allow to cool for 10 minutes at room temperature in a medium bowl.
6. Mix with the maltodextrin and break into small pieces that resemble soil; break into small crumbles for plating.

Figures 1, 2, 3 and 4. *Ingredients of white chocolate sand after addition of 40g of maltodextrin (figure 1); White chocolate sand after addition of extra 15g of maltodextrin (figure 2); Water bath solution for blackberry spheres (figure 3) and 2 elements plated: white chocolate sand and blackberry spheres (figure 4).*

3. Results and discussion

Recipe for "White chocolate crumble" was tested with a few alterations based on class results: maltodextrin had to be added in a higher amount (extra 15g) than previously calculated to reach the desire texture. Red food colorant was tested using powdered and gel colorant, showing the best results with powdered. However, both options resulted in a light pink sand with perceptible particles of maltodextrin. Olive oil flavor overcame the raspberry flavor and white chocolate aroma added and for further tests will be substituted by sunflower oil, an option with less intense flavor.

Blackberry spheres were harder to work with without xanthan gum and for that reason 2g was added to the juice. Spheres were expelled using a syringue. 30g of sugar was excessive and should be reduced to 20g since the spheres tasted too sweet. Also, champagne flavor was too intense and should be removed from the formulation.

4. Conclusion

White chocolate crumble should be prepared with sunflower oil instead of olive oil and powdered colorants should be preferred. Blackberry spheres should be prepared with addition of xanthan gum and 20g of sugar, without champagne flavoring.

5. References

Burke, R., Kelly, A., Lavelle, C. & This Vo. Kientza, H. (Eds) (2021). Handbook of Molecular Gastronomy: Scientific Foundations, Educational Practices, and Culinary Applications. Handbook of Molecular Gastronomy: Scientific Foundations, Educational (routledge.com) CRC Press. (Published on June 9th 2021).

Annex 3: Logbook 3

MODULE TITLE: *Advanced Molecular Gastronomy*
STUDENT NAME: *Laura Moraes Machado*
Note by Note Cooking, class 3

DATE: 17/04/2023

1. Aims and Objectives

1.1 Aim: To develop a note-by-note cheesecake that provides a more sustainable way to incorporate cheese and berries in recipes, extending its shelf-life with interesting textures.

1.2 Objectives:

- Test cream cheese recipe made with 12.5g of milk powder, 125g of water and 20g of lactic acid.
- Test cream cheese recipe made with 12.5g of milk powder, 125g of water and 20g of vinegar.
- Test cream cheese recipe made with 250g of milk and 50g of vinegar.
- Test cheesecake recipe 1 with addition of 2.5g of iota carrageenan.
- Test cheesecake recipe 2 addition of 2.0g of iota carrageenan, 0.5g of lecithin and 0.5g of whey protein concentrate.
- Choose the best one and adjust.

2 Materials and Method (Ingredients, Equipment and Method)

2.1 Materials

Cream cheese FRESH MILK		
Ingredients	Quantity in grams	Quantity in Percentage
Whole milk	500g	96,2
Vinegar/lactic acid	20g	3,8
	520g	100%
Cream Cheese MILK POWDER		
Milk powder	24g	9,8
Water	200g	82,0
Lactic acid/vinegar	20g	8,2
		100%

	Cheesecake 1	
Milk powder	12.5g	4,6
Water	125g	46,0
Cream cheese	75g	27,6
Vanilla flavor	5 drops	0,7
Sugar	52g	19,2
Salt	2.5g	0,9
Iota carrageenan	2.5g	0,9
	271,5	100%
	Cheesecake 2	
Milk powder	12.5g	4,6
Water	125g	46,0
Cream cheese	75g	27,6
Vanilla flavor	5 drops	0,7
Sugar	52g	19,1
Salt	2.5g	0,9
Iota carrageenan	2.0g	0,7
Lecithin	0.5g	0,2
Whey protein isolate	0.5g	0,2
	272	100%

Equipment	
Steel bowl	5
Silicon spatula	1
Whisk	1
Weighing scale	1
Spoon	3
Thermomix TM13	1
Stove (Electrolux Cooking Range 2 burner)	1
Small pan	2
Silicon mold	2
Cloth	1

2.2. Method

Milk

1. POWDER: Mix in milk powder and water.
2. FRESH: bring to a simmer in medium heat.

Cream cheese

1. Heat the milk in a large pot over medium heat, stirring frequently, until it reaches a temperature of about 85°C (185°F).
2. Remove the pot from heat and stir in the lactic acid or lemon juice. The milk will start to curdle and separate into curds (solid) and whey (liquid).
3. Let the milk sit for about 10 minutes to allow the curds to fully form.
4. Line a colander with cloth and place it over a large bowl. Pour the curdled milk into the cheesecloth-lined colander to strain the whey. Let the curds drain until most of the whey has been removed.
5. With a cheese cloth, rinse all the whey with fresh water and remove all liquid.
6. Put the curds in a mixer until smooth and creamy.

Cheesecake 1

1. In a small bowl, whisk together the milk powder and water until fully combined.
2. In a separate bowl, mix the cream cheese, vanilla flavor, sugar, and salt until well blended.
3. In a small saucepan, heat the milk powder mixture over medium heat until it comes to a simmer.
4. Add the iota carrageenan to the milk mixture, whisking constantly until it is fully dissolved.
5. Remove the milk mixture from the heat and add it to the cream cheese mixture, whisking constantly until fully combined and smooth.
6. Pour the cheesecake mixture into a greased or lined pan and refrigerate for at least 2 hours, or until set.
7. Once the cheesecake is set, remove it from the pan and cut into slices or serve as desired.

Cheesecake 2

1. In a small bowl, whisk together the milk powder and water until fully combined.
2. In a separate bowl, mix the cream cheese, vanilla flavor, sugar, and salt until well blended.
3. In a small saucepan, heat the milk powder mixture over medium heat until it comes to a simmer.
4. Add the iota carrageenan to the milk mixture, whisking constantly until it is fully dissolved.
5. Add the lecithin to the milk mixture and whisk until fully combined.
6. Remove the milk mixture from the heat and add it to the cream cheese mixture, whisking constantly until fully combined and smooth.
1. Add the whey protein isolate to the cheesecake mixture and whisk until fully combined.
2. Pour the cheesecake mixture into a greased or lined pan and refrigerate for at least 2 hours, or until set.
3. Once the cheesecake is set, remove it from the pan and cut into slices or serve as desired.


Figures 1 and 2. *Boiling of fresh milk (left) and milk protein curdle after addition of vinegar (right).*


Figures 3 and 4. *Milk and iota carrageenan mixture (left) and cream cheese mixed with sugar, vanilla and salt (right).*



Figures 5 and 6. *Final mixture of milk and cream cheese mixes and moulding before refrigeration.*

Results and Discussion

Tests began by creating the note-by-note cream cheese using milk powder, water, and lactic acid according to the recipe. However, the lactic acid did not start the curdling, milk proteins did not coagulate. 20g of lactic acid was added in combination with 30g of white vinegar and the mixture was let to sit. After 10 minutes there was also no change. For this reason, another trial was made using the same recipe: milk powder was mixed with water according to the ingredients section and 20g of white vinegar was added. There was some curdling of the milk, however, not enough to create cream cheese. 40 extra grams of white vinegar was added and after 10 minutes it was also not in the right consistency. Finally, after following Roisin's suggestion, the following recipe was used to create cream cheese: 500ml of milk and 50g of white vinegar. The desired texture was reached instantly.

After preparation of the cream cheese, recipes 1 and 2 were followed as mentioned on the "methods" above. The mixture of cream cheese, sugar, vanilla, and salt was mixed using a Thermomix to reach a creamy consistency (before this step, the cheese had little crystals of coagulated milk proteins). Milk was prepared using milk powder and water. For the first recipe, the milk and iota carrageenan were added to the Thermomix and thoroughly mixed. For the second recipe, iota carrageenan and lecithin were added to mix with the Thermomix; subsequently, whey protein isolate was added and mixed with a whisk.

Each milk and additives mix were incorporated to their correspondent mix of cream cheese, sugar, vanilla, and salt. The cheesecake "batter" was added to silicon molds and left in the fridge to set until next class.

Conclusions and Recommendations

It was not possible to coagulate milk proteins from milk powder. One of the reasons can be that the milk powder used was skimmed, whereas the fresh milk was full fat. There was a lot of whey waste during production of cream cheese with fresh milk, as 500ml of milk yields 70g of cream cheese. Another recipe for cheesecake without using fresh milk can be tested using milk proteins as a base, and it will be tested if there is time.

If that is not possible, a cheesecake berry jam can be tested using the residual whey protein from the cream cheese recipe, powdered blackberry or blueberry, sugar, and agar-agar. Whey protein should also be incorporated into blackberry spheres to refer to whey waste prevention.

A crumble should be tested for the final dish to complement the cheesecake concept.

Annex 4: Logbook 4

MODULE TITLE: *Advanced Molecular Gastronomy*
STUDENT NAME: *Laura Moraes Machado*
Note by Note Cooking, class 4

DATE: 20/04/2023

1. Aims and Objectives

1.1. Aim: To develop a note-by-note cheesecake that provides a more sustainable way to incorporate cheese and berries in recipes, extending its shelf-life with interesting textures.

1.2. Objectives:

- Test cheesecake recipe 1 with addition of 1.5g of iota carrageenan and 0.5g of lecithin.
- Test cheesecake recipe 2 addition of 4g of iota carrageenan, 1g of lecithin and 1 teaspoon of lactic acid.
- Test crumble recipe prepared with corn starch, maltodextrin, cocoa butter, and sugar.
- Compare texture and flavor results with recipes prepared on logbook 3.

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

2.1. Materials

Cheesecake 1		
Ingredient	Quantity	Quantity in %
Micellar casein	10g	
Whey protein isolate	10g	
Sugar	30g	
Vanilla flavor	1g	
Milk powder	20g	
Lecithin	0.5g	
Iota carrageenan	1.5g	
Water	100g	

	Cheesecake 2	
Micellar casein	25g	7,5
Whey protein isolate	5g	1,5
Sugar	40g	12,0
Vanilla flavor	1g	0,3
Milk powder	10g	3,0
Lecithin	0,5g	0,1
Iota carrageenan	2g	0,6
Lactic acid	1g	0,3
Water	250g	74,7
Crumble		
Maltodextrin	25g	41,7
Starch	10g	16,7
Cacao butter	10g	16,7
Sugar	10g	16,7
Water	5g	8,3

Equipment	
Steel bowl	5
Silicon spatula	1
Weighing scale	1
Spoon	3
Thermomix	1
Stove	1
Piping bag	5

2.2. Method

2.2.1 Cheesecake 1.

1. In a small mixing bowl, whisk together the micellar casein, whey protein, sugar, vanilla flavor, and milk powder until they are fully combined.
2. In a small saucepan, bring the water to a simmer over medium heat.
3. Slowly sprinkle the iota carrageenan into the simmering water, whisking constantly to prevent lumps from forming. Continue whisking for 2-3 minutes, until the carrageenan is fully dissolved and the mixture has thickened.
4. Remove the saucepan from the heat and whisk in the lecithin until it is fully incorporated.
5. Slowly pour the dry ingredient mixture into the saucepan, whisking constantly to prevent lumps from forming.
6. Continue whisking the mixture for 1-2 minutes, until it is smooth and fully combined.
7. Pour the mixture into a greased cheesecake pan and let it cool to room temperature.

2.2.2 Cheesecake 2

1. In a blender, mix together the micellar casein, whey protein, sugar, milk powder, and water until smooth.
2. Transfer the mixture to a saucepan and add the iota carrageenan and lecithin. Whisk until well combined.
3. Heat the mixture over medium heat, stirring constantly, until it comes to a simmer.
4. Reduce the heat to low and continue stirring for 5-10 minutes until the mixture thickens.
5. Remove the mixture from heat and add the lactic acid and vanilla flavor. Stir well to combine.
6. Pour the mixture into a cheesecake mould or baking dish and refrigerate for at least 2 hours or until set.

7. Once the cheesecake is set, remove it from the mould or dish and serve chilled.

2.2.3 Crumble

2.2 Melt the cacao butter in a microwave or on a stove until it becomes liquid.

2.3 In a mixing bowl, combine the maltodextrin, modified starch, and salt.

2.4 Add the melted cacao butter to the dry ingredients and mix well.

2.5 Gradually add water while stirring until you get a crumbly texture that sticks together when pressed between your fingers.

2.6 Spread the crumble on a baking sheet lined with parchment paper.

2.7 Bake at 150°C (300°F) for 8-10 minutes or until lightly golden.

3. Results and Discussion

The first step was to check the cheesecakes prepared in class 3 that were left under refrigeration to set. As can be seen in figure 1, the texture was grainy and resembling cheese and the vinegar used to curdle the milk protein left residual flavour. Besides, these formulations generated a lot of waste, which contradicts the theme of the project.

Figure 1. *Cheesecake prepared with fresh milk curdled with vinegar from the previous class.*

Formulations from “Cheesecake 1” and “Cheesecake 2” were prepared according to the materials and methods section and left in the fridge to set.

Figure 2. *Cheesecake going into mould to set.*

While the batter was left in the fridge to set, a crumble was prepared inspired by a traditional recipe (butter, flour, sugar) to refer to a cheesecake crust. Ingredients were mixed and baked for 15 minutes until golden.

Figure 3. *Cheesecake crumble after baking.*

As can be seen in Figure 3, the particles of maltodextrin are still visible, and the texture of the crumble was somewhat rougher than expected. Perhaps using only sugar instead of maltodextrin would generate better visual results.

Figure 4 and 5. *Blackberry juice ready for spherification (left) and spheres in sodium alginate bath (right).*

The spheres were fragile when scooped out of the sodium alginate bath through the reverse spherification method. For that reason, an extra 2,5g of xanthan gum and 5g of calcium lactate were added to increase its stability. However, as the solution thickened, it became slightly more difficult to expel the liquid, as can be seen in figure 5 (right).

After refrigeration, the cheesecake was ready to be served and the dish was ready to be plated.

4. Conclusions

After reviewing the cheesecake prepared in the previous week, it became clear that it was not suitable for the final dish. Cheesecake 2 was chosen for plating, with its rich flavor and creamy texture, made even more complex with the addition of lactic acid. The reverse spherification method was successfully employed to create the blackberry spheres, which were made more durable with the addition of calcium lactate. While the crumble added a unique texture to the dish, there is certainly room for improvement in terms of its visual appeal.

Annex 5

As mentioned in the conclusion, the appearance of the dish did not meet expectations. If more time were available, probably I would have chosen the pink crumble (figure 1) to compose the dish instead.

Figure 1. *Pink crumble from annex 2.*

From a certain angle, the final appearance resembles a chicken: a comb was added in figure 2 to illustrate (*a little irish humor to give you a break from marking reports)*. The pale color and shape chosen for the cheesecake also remind me of a boiled egg white. What came first, the egg or the chicken?

Figure 2. *Final dish.*

Thanks for everything! With love, Laura.