FIPDes
Food Innovation & Product Design

With the support of the
Erasmus+ Programme
of the European Union

NOTE BY NOTE: FOOD WASTE STILL PERFECT FRUIT SORBET

Alina Auyelbekova
Advanced Molecular Gastronomy
TU Dublin
08.05.23

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Introduction

Molecular gastronomy

Molecular gastronomy is a scientific approach to culinary process that involves understanding of chemical and physical properties of the ingredients (Burke et al, 2021). The new field is involved in creating new textures, flavors and shapes and is often confused with fine dining. Molecular gastronomy combining the science and art, it challenges and pushes the conventional thinking about food and encourages to explore new techniques and bold flavors (This, 2019).

Note-by-note cooking

The note-by-note cooking is an application of molecular gastronomy where the food is created from pure compounds instead of traditional ingredients. It is an approach of thinking about an ingredient in terms of its components, such as proteins, carbohydrates and fats. It is an innovative process that allows to create new dishes with customizable flavor and texture. Although, traditional way of cooking is very important and irreplaceable, note-by-note gives people space for creativity and experiments. Moreover, this type of cooking is more environmentally friendly since it prevents food spoilage and food waste (Burke et al, 2020)

Food waste

The theme of this project-based assignment for the molecular gastronomy class was “food waste” that is considered as a major global issue impacting environment and society. Globally around one third of all the food produced for consumption is lost or wasted equaling to a total of 1.3 billion tonnes per year. To better visualize the problem, this enormous amount of food waste could have potentially fed 3 billion people (Schanes et al, 2017). The food production process has a large environmental impact since it uses water, soil and energy that are ultimately wasted due to food waste. Additionally, it generates significant amount of greenhouse gas emission during the processing. Besides environmental challenges, the crisis also affect the socio-economic matter that leads to food insecurity, hunger and malnutrition (Scherhaufer et al, 2015).

One of the significant sectors that contributes to overall food waste is fruit food waste. According to EU studies, fresh fruits and vegetables contribute to around 50% of food waste generated by households (Laurentiis et al, 2018). Consumers would frequently overbuy the fresh produce which leads to a high chance of spoilage and waste. Moreover, unperfect and damaged produce also has a high chance to be discarded for unappealing image. However, most of overripe fruits are extremely high in moisture and abundant valuable bioactive compounds (Cheok et al, 2017). Fruit waste studies were the source of inspiration for creation of the Still Perfect fruit sorbet. The sorbet, made from overripe and unwanted fruits, could be one of the solutions to avoid extensive food waste.

Furthermore, seeds of fruits are also a widely disposed by-product. Some fruits, such as apple, apricot, pear contain seeds that serve as an important source of protein, carbohydrates, minerals and bioactive compounds (Senica et al, 2017). All these findings led to include and portray the seeds in the presentation of the final product of Still Perfect fruit sorbet.

Aims and Objectives

The aim of this project is to address the issue of food waste and raise awareness of its impact on environment and society. The focus held on creative way to demonstrate how the waste food can be avoided. In particular, showcasing a unique dish using only pure chemical compounds that promotes the sustainable practices. The objective was to adapt the innovative way of cooking learnt throughout the course period and create a dish using undesired or leftover food basis. Giving it a second chance, the project will promote the use of by-product and prevent food disposal habits.

Materials and Methods

Equipment

Equipment used for creating the still perfect sorbet dish are displayed in a table 1.

Table 1. Equipment used.

Robot coupe food processor 	Used to mix ingredients to an ideal consistency
Robot coupe stick blender	Used during foam preparation to create the stiff peak foam.

	

Sorbet

The ingredient list used for creating a Still Perfect fruit sorbet is shown in the table 1.

Table 1. Ingredient list used for fruit sorbet.

Ingredient	Amount used (grams)	Supplier	Role	Compounds
Water	252		Main component used for texture and consistency	H_2O
Glucose syrup 	53	Belgosuc	Provides sweetness and texture	$C_6H_{12}O_6$
Malic acid	5	msk	Compound that is found in many overripe fruits.	$C_4H_6O_5$

			Balances sweetness and enhances fruity flavor.	
Xanthan gum 	1.25	msk	Used as a stabilizer and thickener.	D-glucose D-mannose D-glucuronic acid
Mango powder 	14	Sosa	Source of fruity flavor and color	Glucose Mango puree Sodium alginate
Passionfruit powder	16	Sosa	Source of fruity flavor and color	Glucose Passionfruit puree Sodium alginate

				

In a small saucepan combine water and glucose syrup. To transfer glycose syrup in saucepan, take amount needed with wet hands for ease of handling it. Cook over medium heat until syrup is fully dissolved in water. Remove the saucepan from the stove and let the syrup cool down. Transfer the syrup to mixing bowl and add malic acid, xanthan gum, and fruit powders and stir. Use the Robot coupe food processer until mix is well combined. Transfer the sorbet in a freezer-safe container and freeze until it is firm.

Seeds

The ingredient list used for creating spheres that represent fruit seeds are shown in a table 2.

Table 2. Ingredient list used for “seeds”

Ingredient	Amount used (grams)	Supplier	Role	Compounds
Water	150		The main ingredient for texture and consistency	H_2O
Fructose	31	Sosa	Provides sweetness and improves gel stability and structure of reverse spherification	$C_6H_{12}O_6$

				
Glucose syrup 	20	Belgosuc	Provides sweetness and texture	$C_6H_{12}O_6$
Ascorbic acid 	4.5	India France	Source of antioxidant that stored in seeds of many fruits.	$C_6H_8O_6$
Blackberry powder	14	Sosa	Source of blackberry flavor and	Glucose, Blackberry puree,

			color	Sodium alginate
Agar-agar 	2.5	Sosa	A gelling agent to create firm and flexible spheres.	$C_{14}H_{24}O_9$
Black colorant 	0.4	Sweet stamp	Provides with a desired color	$C_{69}H_{117}N_9O_6RuS_3$

The “seeds” are made using reverse spherification method. In a small saucepan combine water, glycose syrup and fructose. Heat over medium heat and, stirring occasionally. After the sugars are fully dissolved in water,

remove saucepan and let the mix to cool down. Add the rest of the ingredients and use Robot coupe to get homogenous mix. Leave the mix in the fridge for thickening process and later add 3.3g of calcium lactate. Make a sodium alginate bath for reverse spherification combining 500ml of water and 2.5g of sodium alginate. Use vacuum packer to remove the bubbles created during mixing the ingredients for sodium bath and let it in the fridge until the “seeds” mix is ready to proceed with spherification. Using pipette carefully transfer droplets of “seeds” mix into sodium alginate bath and let 2 minutes for spherification process. Using mercer culinary spherification spoon transfer spheres into the water bath to rinse and remove any excess sodium alginate. Once all spheres have been formed and rinsed, store them on a plate until ready to be served.

Foam

The ingredient list used to create a foam that represents mold is shown on a table 3.

Table 3. Ingredient list used for a foam.

Ingredient	Amount used (grams)	Supplier	Role	Compounds
Water	150		Main component used for texture and consistency	H_2O
Fructose 	40	Sosa	Provides sweetness and helps stabilize and enhance the texture of foam	$C_6H_{12}O_6$

Albumin 	20	Sosa	Protein powder used for stable and airy foam	$C_{23}H_{22}Cl_2N_5O^+$
Xanthan gum 	0.5	msk	Thickening agent to great stable and uniform foam	D-glucose D-mannose D-glucuronic acid

In a large mixing bowl combine all the ingredients and mix it using hand mixer on a high speed until foam forms stiff peaks.

Tuille

The ingredient list used to create tuille that represents the mold of overripe fruits is shown in table 4.

Table 4. Ingredient list used for tuille.

Ingredient	Amount used (grams)	Supplier	Role	Compounds
Water	80		Main component used for texture and consistency	H_2O
Corn flour	8.5	Gem	Provides with structure and	$\mathbf{(C_6H_{10}O_5)_n}$

			crispiness	
Gluten 	1.5	Spiegelhauer	Additional ingredient to help with structure and texture	$C_{29}H_{45}N_5O_8$
Green colorant 	Drop	Goodall's	Provide with a desired green color	$C_{27}H_{25}N_2O_7S_2Na$

Combine corn flour, gluten powder and water in a medium mixing bowl until mixture is smooth and free of lumps. Add colorant and whisk until the color is uniform within the mix. Fry the mixture on a medium heat to achieve a thin layer of tuille.

Results and Discussion

The final dish that represented my vision of food waste and the story of by-product is shown in the figure 1 and 2.

Figure 1. Final dish of Still perfect fruit sorbet.

Figure 2. Close up photo of the final dish.

Fruit sorbet was created with molecular gastronomy cooking techniques and utilized the ingredients such as fruit powders, sugars, malic acid and xanthan gum. The idea behind was inspired by the destiny of overripen fruits that are usually discarded and wasted but could potentially be transformed into delicious dessert. The recipe could have been as simple as combining fruit powders and water, but it was decided to additionally implement xanthan gum as a stabilizing and thickening agent that helps sorbet to have smoother and creamier texture. This polysaccharide is known to be versatile component that is soluble in both cold and hot water (Burke et al, 2021). Furthermore, malic acid and glucose were added in the final recipe that naturally found in majority of fruits. Glucose was chosen because of its content tent to increase during fruit ripening in comparison to sucrose. Malic acid is organic acid that is found in a wide range of fruits and is present in high concentrations during fruits midripe maturity (Glew et al, 2005). The

acid is added in the recipe to give tart, acidic flavor and to balance sweetness of the sorbet. The final sorbet turned out to be sweet, smooth with a bit of an acidic kick that got a positive response form students who tried it.

The spheres are made to represent the seeds as a by-product of fruits that are full of nutrients. The seeds of fruits such as mango, tamarind and avocado showed much higher antioxidant activity than the edible part of a fruit (Soong, 2004). Therefore, it was decided to add the ascorbic acid as an antioxidant compound.

Final version of seeds were made using reverse spherification technique that resulted in a more stable spheres. They turned out to be smooth and firm due to addition of agar-agar. There was a visible difference in overall shape, texture and appearance of the spheres that include gelling agent and the ones that don't. The spheres that didn't contain agar-agar, were waterier and clearer with less dense consistency as shown on the figure 3 (a). In contrast, figure 3 (b) shows the sphere made with agar-agar and they look fuller, juicier and plump. On a sensory aspect, all individuals who tried both versions preferred the one that contains agar-agar.

(a)

(b)

Figure 3. The comparison of spheres without agar-agar(a) and spheres with agar-agar (b).

To portray overripe and spoiled fruit, foam was made to represent the mold particles on the fruits. Foam was created by combining all the ingredient and

whisking them together until firm desired consistency of the foam. The addition of an egg white protein powder was implemented for the right foam texture shown on the figure 4 (a). Albumin is a large protein which amphipathic duality makes it a great surfactant. The albumin molecules form a protein network that traps air bubbles and provides stable foam structure (Razi et al, 2019). The foam without albumin was also made to show the difference between both foams and the importance of an albumin (Figure 4 (b)).

(a) (b)

Figure 4. A comparison of foam with albumin (a) and foam without albumin (b)

Tuille was made to add on to the existing white foam mold and create even stronger picture of an unwanted fruit. Most of the overripe, spoiled fruits generate the fluffy fungal growth with white and green colors (Figure 5). Thus, it was decided to make a green tuille. The main ingredient for which is a gluten that forms long chains when mixed with water. This creates network that traps air bubble and provides tuille with its light and crispy texture (Si et al, 2020).

Figure 5. Moldy fruit.

Conclusion and Recommendations

The Still Perfect fruit sorbet that was inspired by the waste of overripe and spoiled fruits and their seeds was created using molecular gastronomy techniques. The project demonstrated how waste and by-products could be transformed and repurposed for example into a delicious dessert. The innovative approach to a culinary art encourages to use only pure chemical compounds such as fructose, xanthan gum, different types of acids. The experimental trials of molecular gastronomy led to a successful result of fruity sorbet with creamy texture.

Despite that the sorbet mostly got positive feedback on its verbal sensory, there is still a room for improvements. It is recommended to conduct more kitchen trial and experiment with ingredients to achieve a better texture of a sorbet as well as of “seeds”. Further research could be conducted in detailed analysis of compound that are present in overripe fruits and fruits seeds. Additionally, it is important to continue to spread awareness about food sustainability as well as educate and encourage people to reduce their food waste.

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Appendices

Appendix I. Logbook 1

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy
STUDENT NAME: Alina Auyelbekova
FOOD PRODUCT: Overripe fruit sorbet
WEEK NO.: #1 **DATE: 20/03/23**

Weekly Aims and Objectives

The aim for this week trials was to familiarize myself with the ingredients and to try to figure out the sorbet composition. The objectives were to make a sorbet with vivid mango flavor.

Materials and Method (Ingredients, Equipment and Method)

Ingredients for fruit sorbet:

- 252g water
- 53g glucose syrup
- 20g brown sugar
- 5g malic acid
- 1.25g xanthan gum

- 14g mango powder
- 16g passion fruit powder

Heat up water with glucose syrup and brown sugar in a small size saucepan, until sugars dissolve. Take the pan from the stove and then stir in malic acid and xanthan gum. After, add mango and passion fruit powders and whisk everything together until homogenous. Pour the mix in the bowl using sieve and place it in the blast freezer.

Results and discussion

Figure 6. The fruit mix sorbet.
Xanthan gum and fruit powders couldn't properly dissolve in the hot sugared water. So had to use sieve to separate the liquid mix with agglomerates. Will probably need to dissolve xanthan gum in a cold water before adding to the mix. Will try the same technique with fruit powders to see if they dissolve better in cold water. After freezing, the texture and flavor of the sorbet was good, will keep the proportions of the ingredients, but will increase the amount of sugar (glucose syrup).

Conclusions
Sorbet turned out to have a good taste. In conclusion it just needs minor adjustment in the recipe but overall satisfied with the outcome.
Recommendations for following week.
Next week will try to make bubbles that will represent the seeds of fruits that also wasted.
And try to achieve smoother and more homogeneous mix for the sorbet as well as to try to have a shape for sorbet.

Appendix II. Logbook 2

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Alina Auyelbekova
FOOD PRODUCT: Over ripe fruit sorbet
WEEK NO.: #2 **DATE: 27/03/23**

Weekly Aims and Objectives

The aim for this week trials was to focus on making spheres for the dish that is going to represent seeds. The objectives were to make spheres with component of fruit seeds like papaya.

Materials and Method (Ingredients, Equipment and Method)

Ingredients for coconut sphere:

- 150g water
- 50g fructose
- 3g ascorbic acid
- 3 drops of coconut flavor
- <1g black colorant

Heat up water with fructose to dissolve sugar in a small saucepan. After sugar fully dissolved take the pan from the stove and then stir in ascorbic acid and coconut flavoring. Add 0.75g of sodium alginate and mixed using robocoupe.

Make Calcium bath:

- 1000g water
- 5g Calcium chloride

Using pipette make droplets of mix into the calcium bath to create spheres.

Results and discussion

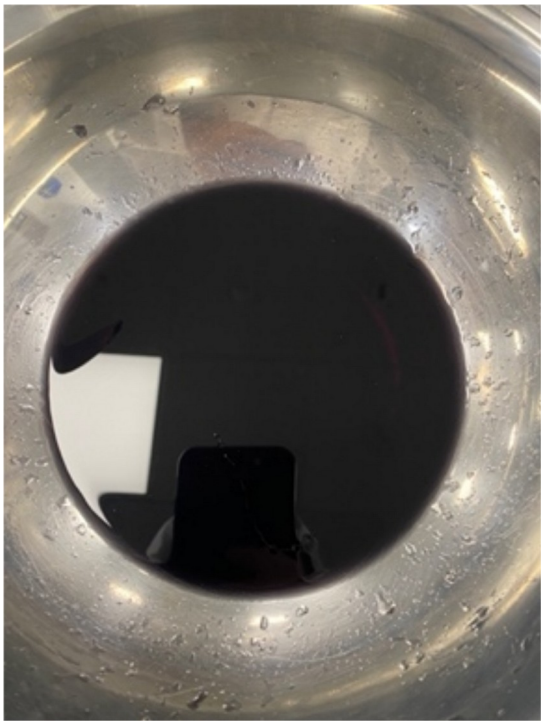

Figure 7. Mix to create black spheres.

Figure 8. Black “seeds”.

Without any thickener spheres were a little too pale and very watery. As well as the taste was not really defined, couldn’t detect coconut flavor. Tasted like water with sugar. Will have to adjust.


Figure 9. Final presentation of the dish. Fruit sorbet with fruit seeds

Even if spheres were too clear, without enough black pigment overall dish presentation was acceptable.

Conclusions
Absence of thickening agent in the recipe for “seeds” resulted in less desirable product, that was too watery and clear. Spheres also lacked flavor because coconut flavoring isn’t strong.

Recommendations for following week.
Next week will try to make denser spheres with an addition of thickener, as well as improve the taste. Possibly substitute coconut flavor with a different one.

Appendix III. Logbook 3

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy
STUDENT NAME: Alina Auyelbekova
FOOD PRODUCT: Over ripe fruit sorbet

WEEK NO.: #3 **DATE: 17/04/23**

Weekly Aims and Objectives

The aim for this week trials was to focus on making denser spheres for the dish that is going to represent seeds. The objectives were to make spheres with better taste and texture.

Materials and Method (Ingredients, Equipment and Method)

Ingredients for fruit sphere:

- 150g water
- 31g fructose
- 20 glucose syrup
- 4.5g ascorbic acid
- 2.5g agar-agar
- 14g blackberry flavor powder
- <1g black colorant

Heat up 100g water with fructose and glucose syrup to dissolve sugar in a small saucepan. After sugar fully dissolved take the pan from the stove and then stir in ascorbic acid and blackberry flavoring powder. Mix 50g of water and agar-agar and add it to the syrup mix. Cool it down and place it in the fridge for thickening.

After the mix cooled down divide it in two to proceed with types of spherification. For basic spherification, to 100g of mix add 0.5g of sodium alginate and mix using robot coupe.

Make Calcium bath:

- 1000g water
- 5g Calcium chloride

Using pipette make droplets of mix into the calcium bath to create spheres. Transfer the spheres into the water bath.

For reverse spherification, add 3.3g of calcium lactate. Transfer the mix to sodium alginate bath using pipette, allowing 2-3 minutes to set.

Sodium alginate bath:

- 500ml water
- 2.5g sodium alginate

Results and discussion

For the thicker types of spheres that I attempted to make this week, it was better to use reverse spherification in comparison to the basic spherification. Basic spherification could not make spheres and resulted in flat particles of mix.

Figure 10. Basic spherification

Reverse spherification in contrary resulted in spheres with thicker membrane.

Figure 11. Black “seeds”

With substitution of a flavor from coconut to blackberry, spheres were tastier and more likable. Furthermore, addition of agar-agar resulted in better colored and textured spheres that were also denser.

Conclusions
Although I couldn't achieve desired black color for spheres, the addition of thickening agent and change in flavor for the recipe definitely improved the overall appearance and taste of the spheres that will represent the "seeds". Changing the recipe for the sphere resulted in changing the method of spherification.
Recommendations for following week.
Next session is the last kitchen trial for the molecular gastronomy; hence the dish must be ready for presentation. I will repeat the reverse spherification and try to assemble the final dish.

Appendix IV. Logbook 4

MODULE CODE: TFCS9025
MODULE TITLE: Advanced Molecular Gastronomy
STUDENT NAME: Alina Auyelbekova
FOOD PRODUCT: Overripe fruit sorbet
WEEK NO.: #4 **DATE: 21/04/23**

Weekly Aims and Objectives
The aim for this week trials was to finalize and assemble final dish. The objective was to portray the sorbet from spoiled overripe fruit.
Materials and Method (Ingredients, Equipment and Method)
The sorbet was used form week #1 with the same ingredient list and the same method:

- 252g water
- 53g glucose syrup
- 20g brown sugar
- 5g malic acid
- 1.25g xanthan gum
- 14g mango powder
- 16g passion fruit powder

The mix for spheres as well as sodium alginate were also prior prepared during week #3
Ingredients for fruit sphere:

- 150g water
- 31g fructose
- 20 glucose syrup
- 4.5g ascorbic acid

- 2.5g agar-agar
- 14g blackberry flavor powder
- <1g black colorant

For reverse spherification, add 3.3g of calcium lactate. Transfer the mix to sodium alginate bath using pipette, allowing 2-3 minutes to set.
Sodium alginate bath:

- 500ml water
- 2.5g sodium alginate

For presentation it was chosen to use white foam and green tuille to portray the spoilage and unappealing perception.

Ingredients used for foam:

- 150g water
- 40g fructose
- 20 albumin powder
- 0.5g xanthan gum

Al the ingredients were whisked together at first and then mixed using robot coupe until stiff peaks.

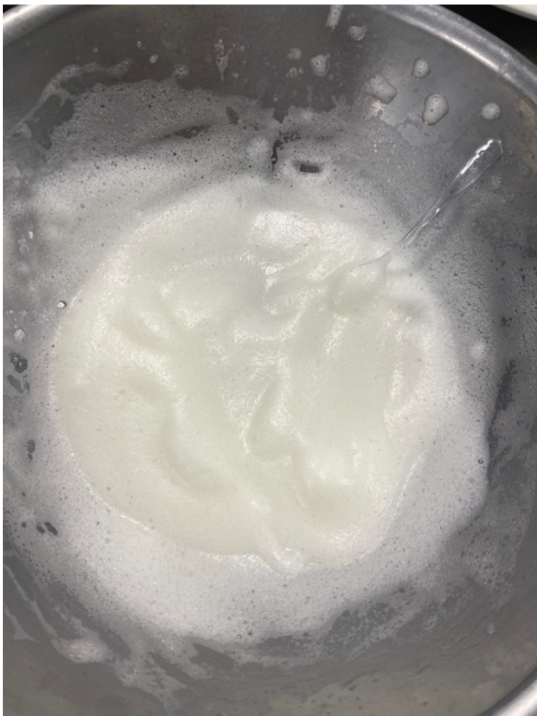

Figure 12. Foam

Ingredient list for green tuille:

- 80g water
- 8.5g corn flour

- 1.5g gluten
- Drop of green colorant

Combine corn flour, gluten powder and water in a medium mixing bowl until mixture is smooth and free of lumps. Add colorant and whisk until the color is uniform within the mix. Fry the mixture on a medium heat to achieve a thin layer of tuille.

Results and discussion

The sorbet was transferred into soup ladle for the circular shape that is inherent to most fruits.

Following recommendation of last week kitchen trials, it was concluded to use a reverse spherification for making fruit “seeds” to create denser and fuller spheres.

The presentation of the final dish is an important aspect of the project, so it was decided to emphasize the spoilage of the fruit with mold created with foam and tuille as seen on a figure 13.

Figure 13. Final dish presentation.

Conclusions

The final product turned out to presentable and had a positive response to its visuals. However, there is still room for improvement is overall taste and appearance.