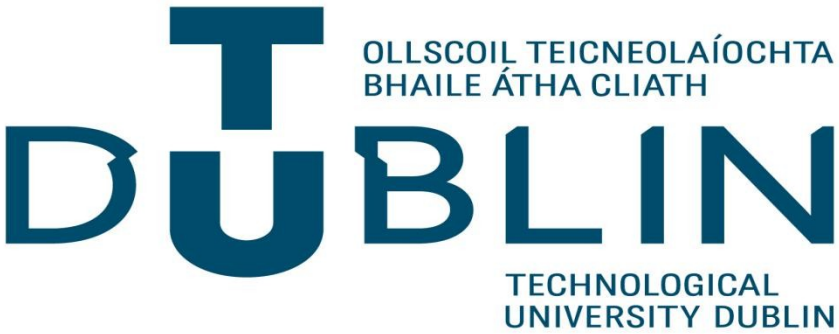

ADVANCED MOLECULAR GASTRONOMY

TFCS9025 NOTE-BY-NOTE REPORT

BY LYNDA NECHAVAVA

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INTRODUCTION

Molecular gastronomy has been defined as a scientific discipline that seeks to explore the science behind cooking and takes particular interest in the sensory aspect of the product as opposed to traditional cooking (Kitchentherdev, 2023). In an article from 2010, Peter Barham a physicist further described molecular gastronomy as the scientific study behind why food can have varied tastes and whether this can be attributed to the ingredients, the cooking methods, the serving environment, or can be traced back to the origin of the ingredients used (Charles Spence a et al., 2018). These definitions differentiate molecular gastronomy from food science which is mostly centered on the technology behind food formulation and gives little to no emphasis on the sensory visual properties of the product. Two scientists, Nicolas Kurti and Herve This are believed to be the found fathers of molecular gastronomy which has formed a culinary movement inspired by enthusiasm that leads to the creation of a range of dishes spanning from sauces and foams to bubbling nitrogen and the most famous caviars formed through spherification ((YEK & Struwe, 2008) On the other hand, Harve This developed another cooking method which involves use of pure compounds or a mixture of compounds obtained from fractioning of plant and animal tissues (Kitchentherdev, 2023). It does not use meat or vegetables to make food but instead draws inspiration from them and uses compounds to make dishes with resemblance some of the existing foods. It was first proposed in 1994 as a way to improve dishes but has since been transformed into molecular cooking which takes shape, colors, nutritional aspects, and other characteristics into consideration (Kitchentherdev, 2023). According to its founder Harve This, Note by Note cooking promises to bring a sustainable approach to cooking by being more energy efficient and environmentally sustainable (This, 2017). The idea of not using traditional foods is foreign to many which prompts chefs and scientists to think outside the box about producing nouvelle dishes while taking into consideration the food safety and nutritional aspects of the dishes prepared (Burke & Danaher). Note by Note cooking seeks to address the challenge of food shortages which have been forecasted due to the increasing human populations and increasing levels of food waste which are resulting from unsustainable food production practices (This, 2016). Food waste happens in the food system from farmers, and distributors right to the consumer. While food ‘lose’ happens because of processing or storage, food ‘waste’ happens when food fit for consumption is consciously discarded by retailers or consumers (Food Waste, 2022.) According to a report by Board Bia (2019), 1/3 of the food in the world goes to waste which is equivalent to 1.3 billion tonnes every year. Food waste is not just about the food, but the resources involved in the

processing and storage and also the effects of disposal against emitting global warming gases. The bulk of food waste occurs at the consumer level (52%) while 23% occurs at the production level. (Bia, 2019). Though there has been measures to mitigate food waste after production like donation and recycling, controlling food waste at manufacturing/ production provides a more sustainable means of control. Some of the suggested ways include portion size control and improved forecasting in terms of ingredients needed. Molecular gastronomy can be applied in both instances and help in fighting food waste.

AIMS OF THE ASSIGNMENT

Aims

- Produce a note-by-note dish using the brief 'food waste
- Explain the dish in relation to the concept of food waste
- Present the dish at the final class

Objectives

- Create a dish of bread and fruit using pure compounds that interprets food waste
- Explain each components of the dish and their relationship to food waste
- Present the full dish on the last day of class and write a report

MATERIALS AND METHODS

Equipment	Model
Oven	Electrolux
Stove	Hobb
Blast freezer	Sagi
Fridge	Olive
Digital scale	N/A
Kitchen scale	SilverCrest
Temperature probe	N/A
Whisker	N/A
Bowl	N/A
Pippete	N/A
Pastry cutter	N/A
Baking tray	N/A
Parchment paper	N/A

Table1: List of equipment

Ingredient	Quantity (g)	Supplier

Water	50	
Rice flour	48.8	
Xanthan gum	11.5	MSK
Egg white powder	10	SOSA
Olive oil	1.04	
Lactic acid powder	0.83	MSK
Lecithin	0.42	SOSA
Baked bread flavour	1.25	MSK
Sugar	15	
Baked bread flavour	10	MSK

Table 2 : List of ingredients for bread

Methodology

1. Weigh all the ingredients (quantities mentioned in table above)
2. Add egg whites and 70g of water and whisk to a foam (10 minutes)
3. Add the rest of the ingredients to a separate bowl and mix for 2 minutes
4. Add the mixture to the eggs whites foam and fold into the whisked eggs carefully not to break the foam
5. Place in a lined baking tray (onto pastry cutters) and bake at 210°C for 15 minutes
6. Remove from oven and place on a cooling rake.

Figure 1: Bread mix

Ingredient	Quantity (g)	Supplier
Isomalt	200	MSK
Water	20	

Table 3: List of ingredients for isomalt dome

Methodology

1. Weigh all the ingredients using a digital scale
2. Wrap a bowl tightly around cling wrap
3. Add water and Isomalt to a pot and bring to a boil until all the isomalt dissolves
4. Reduce the heat and let it simmer on low heat until it reached a temperature of 175°C-185°C
5. Remove from heat and let it cool to 165°C (needs to thicken to a honey consistency)
6. While cools, grease the inside of a cookie cutter
7. Pour 10ml on the wrapped ball and place the blunt side of the cookie cutter around and apply pressure slowly and the dome will start forming
8. Let the sugar cool and release (leave it while still warm so the plastic is easy to remove
9. Carefully remove the plastic from underneath

((Lexis, 2022)

Ingredient	Quantity (g)	Supplier
Water	70	
Mango powder	30	SOSA
Apple powder	30	SOSA
Agar agar	2.4	SOSA
Sugar	10	
Olive oil	350	
Banana & Apple Flavors	8	MSK

Table 3: List of ingredients for caviar spherification

Spherification Method

1. Weigh all ingredients using a kitchen scale and a digital scale
2. Place oil into a blast freezer and let it cool at -21°C for 10 minutes
3. Add mango powder, agar agar, water and sugar, place on the stove, and bring to a boil
4. Reduce heat and let it simmer for 3 minutes
5. Remove from heat, add flavour and let it cool for 2 minutes
6. Use a pipette to extract and drop into cold oil
7. Strain the caviars and rinse under cold water
8. Store in a fridge for preservation
9. Repeat the same process for apple caviars

RESULTS

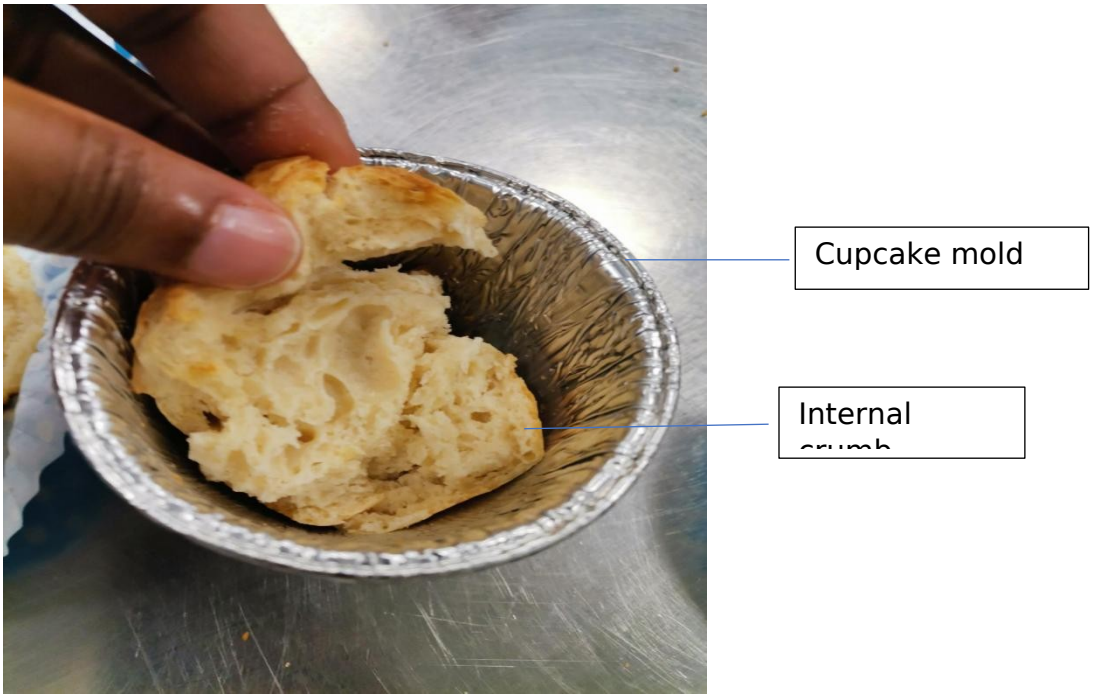


Figure 2: Final bread crumb structure

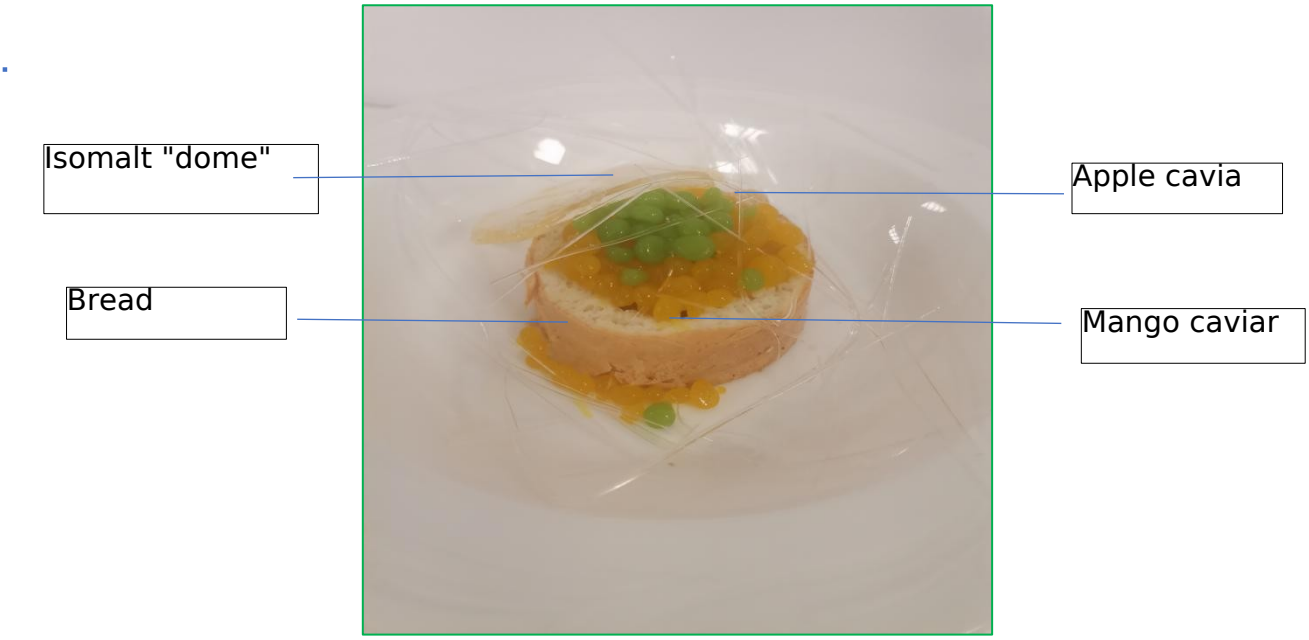


Figure 3: ‘Dirty bread’

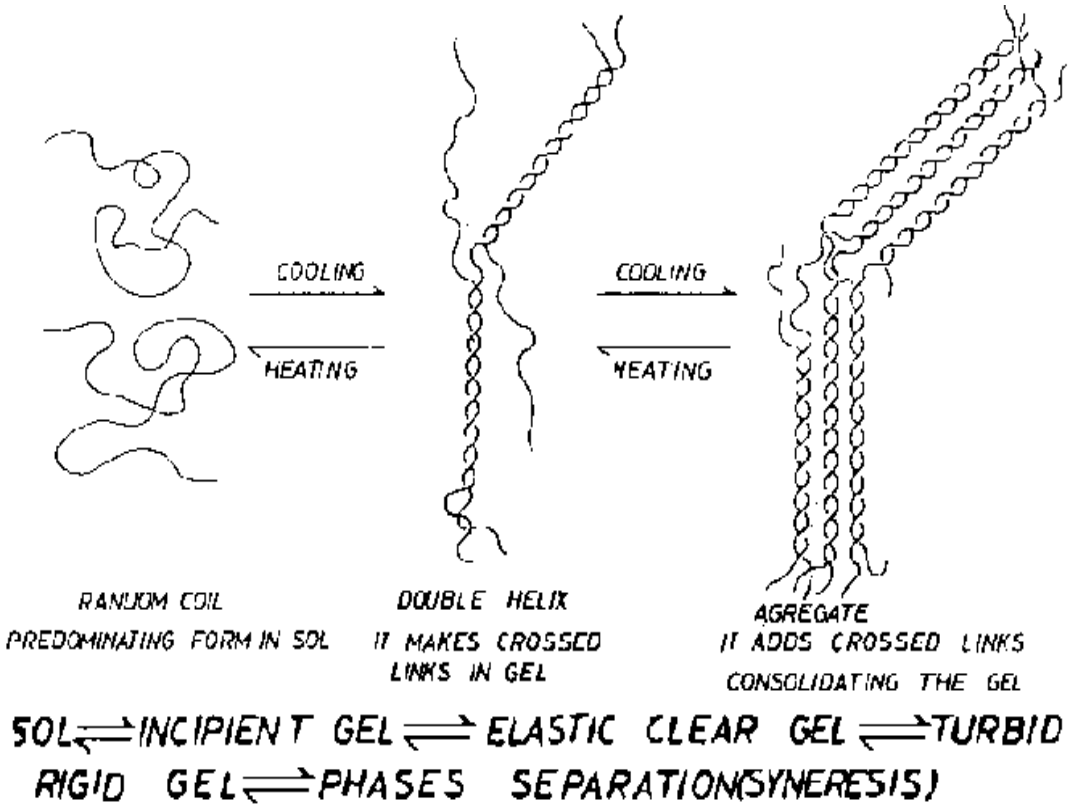
DISCUSSION

Bread

As mentioned in the aims, the project was to raise awareness on food waste by demonstrating a sustainable way of presentation and production of smaller portions as overproduction is responsible for a significant part of food waste. Over 240 million slices of bread are thrown away every year and 18% of the losses happen at the consumer level. (Fearnley, 2023: Southey, 2020). Xanthan gum is a chain of building blocks made by fermenting simple sugars with xanthomonas campestris used in gluten-free baked goods due to its ability to mimic gluten properties (WebMD,2020). As a carrier of preservatives, it has been proven to extend shelf life. Molding has been noted as one of the reasons bread is thrown away and molding can be controlled by lactic acid. Lactic acid is an organic product formed during the reduction of pyruvic acid by lactate dehydrogenase. Lactic acid has preservative properties due to its ability to produce anti-microbial substances such as hydrogen peroxide and organic acids. Antimicrobial substances are produced through the dissociation of protons which lowers extra cellular ph followed by diffusion of acid into the cell affecting cell metabolism which creates a chain of inhibition of other metabolic processes (Janssen et al., 2007). Lactic acid has a ph of 2.43 and any ph below 2.5 can slow down or kill molds. Lactic acid and lecithin increase the shelf life while also improving the flavor. Bread was used as a symbol of food waste to demonstrate waste control and production level by reducing portion size and adding preservatives to extend shelf life. With more time, this project can be extended to controlling food waste at the consumer level which accounts for the biggest percentage of waste as mentioned earlier. The air bread was fluffy and full of flavor. Due to the sugar and milk proteins, it also had a golden-brown crusting which was soft in contrast to the traditional bread.

Caviar Spherification

According to an article by Frontiers in Nutrition, (Lau et al., 2021), about 45% of fruit and vegetables are wasted worldwide, making it the highest waste category. This is because they have a short shelf life and are sensitive to storage conditions. Fruit respiration is the major culprit in fruit spoilage, and it is mostly difficult to control this parameter in the natural environment as it is affected by external factors like temperature and humidity. To counter this, there has been advancements in food preservation methods with drying and canning being the most adopted methods. This has however not been significant in other parts of the world, for example Sub Saharan Africa which produces a lot of fruits but constitutes about 20% of the world's fruit and vegetables waste (Lau et al., 2021). Fruit caviar was incorporated into the dish to demonstrate an alternative way of preserving fruit by producing fruit powder which can be reconstituted with convenience when needed. Fruit powders have an extended shelf life for example, those made by PrepSOS have a 10-year shelf life. A reduction in fresh fruit and vegetable loss can ease the pressure on food production systems considering the increasing world population and climate change affecting agricultural activities.



Agar agar is a widely used hydrocolloid in the food industry due to its unique gelling properties which include thermorevesible gelling at

Figure 4 : Agar Agar reactions to temperature ((Bravo, 2019)

low concentrations, resistance to low ph, and setting temperatures. The fruit solution was heated to 100°C, the temperature at which agar agar dissolves. With a setting temperature of 35 °C - 40 °C it forms a stable gel room temperature, and it has a neutral taste which makes its applications broader. The mango caviars did not produce the expected amount of flavour and had a bitter taste. The recipe needs an adjustment on the sugar and flavour ratios to mask the acidity, perhaps add more sugar as real mangoes are high in sugar. According to an article by Web MD 1 mango contains 46g of sugar (Mikstas, 2021)

Isomalt Dome

The isomalt dome was a contingency plan because there was insufficient time to make edible plastic wrap. Edible packaging is made from biodegradable plant material that can be consumed and is applied as a coating or wrapping around the food. They contain antioxidants and anti-microbials which have been exhibited to increase the shelf life of meats, meat products, and fresh and cut fruits (Supraja, 2022). Isomalt is a sugar substitute made from sugar alcohols and has a melting point of 145°C-150°C (Rose, 2021). For this dish, however, an isomalt dome was

proposed just for presentation purposes but after several trials, it was not possible to produce the required shape. A bowl was double wrapped tightly with cling film and 10ml of isomalt at 165°C was placed using a spoon. A cookie cutter (blunt side) was used to press slowly to form the glass doom. The hot isomalt heated the plastic resulting in the thermal expansion of the air. The air became dense and was forced upwards in a doom shape as guided by the cookie cutter (Vedantu, 2022). The process required several trials in order to reach the desired shape size, giving at least 10 minutes in between for the isomalt to solidify.

Figure 5: Isomalt glass dome (Jan 2022)

CONCLUSION

The aim of the assignment was achieved as a note-by-note dish was created and it came with a fair share of challenges. A ‘dirty bread’ was created to raise awareness on some of the most wasted foods in the world. The biggest hurdle to achieving the intended dish was time constraints. Using compounds results in chemical reactions which sometimes can not be anticipated and hence require time to do research and do trials until the intended results are achieved. The ‘bread’ part of the dish, the taste, appearance, and aroma were satisfactory, but the crumb structure was open and lacked consistency. The same cannot be said for the other parts of the dish which produced beyond unsatisfactory results. More time was needed to establish the causes of the deviations from the expected results and conduct more trials but a decision was made to move on to different recipes instead because of time. No microbial, nutritional analysis or shelf life studies were carried out for this dish which brings about a question of not just the safety of the dish but also if it is within EU regulations since there are yet no laws specifically applied to this type of cooking. Though some notes can be borrowed from existing laws of permitted food additives and their limits, this does not give an overall picture in terms of compliance to law. Finally, it is also important to note the sustainability of the production process which proved to be not in support of reducing food waste as it resulted in a considerable

amount of waste.The subconscious interpretation of this brief would be to reduce food waste in the process of raising awareness. However, there is room for research and improvement.

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APPENDIX

LOGBOOK

MODULE CODE: TFPD9022

MODULE TITLE: ADVANCED MOLECULAR GASTRONOMY

STUDENT NAME: TFCS9025 2022-23

FOOD PRODUCT: Crystal bread

WEEK NO: 1 **DATE: 20/03/2023**

Weekly Aims and Objectives

Aims:

- To make a crystal bread

Objectives:

- Make crystal bread using tapioca flour as a replacement for kuzu starch

Materials and Method

Ingredients	Quantity (g)
Water	300
Tapioca flour	10
Rice flour	10
Potato starch	10
Sunflower oil	10

Table 1: List of ingredients

Equipment	Model
Kitchen Scale	Silvercrest

Stove	Hobbs
Digital scale	Silvercrest
Whisker	n/a
Pot	n/a
Bowl	n/a
Cupcake mould	n/a
Pot	n/a

Table 2: List of equipment

Method

1. Weigh ingredients using a kitchen digital scale and the water using a kitchen scale
2. Place all the ingredients in a pot and bring to a boil while whisking
3. Reduce the heat and simmer for 5 minutes while stirring
4. Remove from stove and divide into 5 moulding cupcakes
5. Place in a preheated oven at 150°C for 90 minutes, reduce heat to 120°C and bake for another 45 minutes.
6. Remove from oven and brush with sunflower oil and bake again for additional 10 minutes.

Results and discussion

Due to the class starting 1h 30 minutes late, the method could not be completed as the baking needed more time. A mixture of the ingredients was precooked, vacuum packed and stored for the following week.

Conclusions N/A

Recommendations for following week.

- Continue with this week's recipe

MODULE CODE: TFPD9022

MODULE TITLE: ADVANCED MOLECULAR GASTRONOMY

STUDENT NAME: TFCS9025 2022-23

FOOD PRODUCT: Crystal bread

WEEK NO: 2 **DATE: 27/03/2023**

Weekly Aims and Objectives

Aims:

- To bake crystal bread mix from last week
- Make edible wrapping

Objectives:

- Bake the kuzu starch mix from last week
- Make edible wrapping

Materials and Method

Ingredients

Ingredient	Quantity (g)
Cold water	400
Gelatine (food grade)	10
Glycerine	2.5
Plastic flat lids	5

Table 1: List of ingredients

Kitchen Scale	
Stove	
Digital scale	
Saucepan	
Wooden spoon	

Table 2: List of equipment

Method

1. Pour water in a saucepan
2. Sprinkle the gelatin over the surface of the water
3. Place on a stove at low heat and heat until the liquid is crystal clear (do not boil)
4. Spoon the mixture onto the plastics lids and spread evenly by tilting
5. Put in an open area and allow to dry for 2 days
6. Check results

(Whats4Chow, 2018)

Results and discussion

For the crystal bread did not produce the intended results. Kuzu starch was replaced by Tapioca flower as they both have the same properties. Kuzu starch is made from kudzu roots, and it originates from Japan. It has a gelatinization temperature of 60°C and a pasting temperature° of 70°C -75°C which is in the same range as Tapioca starch. For the edible wrapping, the wrapping was too thick, and amounts can be adjusted for the following weeks.

Conclusions

Even with the same gelatinization and pasting temperature, kuzu and tapioca starch could not be interchanged for this assignment.

Recommendations for following week.

- Remake plastic wrapping
- Change bread recipe

MODULE CODE: TFPD9022

MODULE TITLE: ADVANCED MOLECULAR GASTRONOMY

STUDENT NAME: TFCS9025 2022-23

FOOD PRODUCT: 'dirty bread'

WEEK NO: 3 **DATE: 17/04/2023**

Weekly Aims and Objectives

Aims:

- To make an air bread using note-by-note cooking
- To finalize the recipe for the dish for the note-by-note assignment

Objectives:

- To make try 2 recipes for a compound bread and finalize recipe for the assignment
- To make do make apple and banana caviar for toping the bread

Materials and Method

Kitchen Scale	Silvercrest

Stove	Hobbs
Digital scale	Silvercrest
Whisker	n/a
Pot	n/a
Bowl	n/a
Cupcake mould	n/a
Pot	n/a

Table 1: List of equipment

Ingredient	Quantity (g)
Rice flour	50
Corn flour	11.5
Dried milk powder	11.5
Sugar	15
Xanthan gum	1.15
Salt	0.23
water	61.5

Table 1: List of ingredients (Recipe 1)

Methodology

- Weigh all ingredients using a kitchen scale
- Add the rest of the ingredients and make a butter
- Place in oiled cupcakes mold and bake in a preheated oven and bake at 180°C for 40 minutes
- Remove and cool on a cooling rake

Ingredient	Amount (g)	Supplier
Water	50	
Rice flour	48.8	

Xanthan gum	11.5	
Egg white powder	10	SOSA
Olive oil	1.04	
Lactic acid powder	0.83	MSK
Lecithin	0.42	SOSA
Baked bread flavour	1.25	MSK
Sugar	15	
Baked bread flavour	10	MSK

Table: List of ingredients (recipe 2)

- Weigh all the ingredients
- Place egg white powder in a bowl, add 70gof water a whisk with a hand whisker for 5 minutes (until eggs whites are fluffy)
- Add the rest of the ingredients to a separate bowl and mix for 2 minutes
- Add the mixture to the eggs and fold into the whisked eggs carefully not to break the foam
- Place in a lined baking tray (onto pastry cutters) and bake at 220°C for 15 minutes
- Remove from oven and place on a cooling rake.

Fruit caviar

Ingredient	Quantity (g)
Water	70
Mango powder	30
Apple powder	30
Agar agar	2.4
Sugar	10
Olive oil	350

Table 3: List of ingredients for fruit caviar

Recipe

1. Weigh all ingredients using a kitchen scale and a digital scale

2. Place oil into a blast freezer and let it cool at -21°C for 10 minutes
3. Add fruit powder, agar agar, water and sugar, place on the stove, and bring to a boil
4. Reduce heat and let it simmer for 3 minutes
5. Remove from heat, add flavor and let it cool for 2 minutes
6. Use a pipette to extract and drop into cold oil
7. Strain the caviars and rinse under cold water
8. Store in a fridge for preservation
9. Repeat the same process for apple caviars

Results

The first recipe did not produce the desired results. The structure of the bread resembled that of gluten-free bread, but it was too dense, sticky had a strong bitter taste. The second recipe had a more open structure and a more acceptable taste. The results for the fruit caviars were also acceptable, they were stable after washing with cold and had a flavourful taste.

Figure 1: A) Recipe 1 B) Recipe 2

Conclusions

The second bread recipe and fruit caviar were adopted as the recipe for the final dish

Recommendations for following week.

- Prepare isomalt dome

- Replicate recipe 2 for final dish

MODULE CODE: TFPD9022

MODULE TITLE: ADVANCED MOLECULAR GASTRONOMY

STUDENT NAME: TFCS9025 2022-23

FOOD PRODUCT: Crystal bread

WEEK NO: 4 **DATE: 21/04/2023**

Weekly Aims and Objectives

Aims:

- Make Isomalt dome
- Present the final dish for the assignment

Objectives:

- Use isomalt to make a dome as a 'cover' for the final dish
- Use recipe 2 from last week to make bread for the final presentation
- Combine all the pieces of the dish and present

Materials and Method (Ingredients, Equipment and Method)

Ingredient	Quantity (g)
Isomalt	200
Water	20

Table 1: List of ingredients

Recipe

1. Weigh all the ingredients
2. Wrap a bowl tightly around cling wrap
3. Add water and Isomalt to pot and bring to a boil until all the isomalt dissolves
4. Reduce the heat and let it simmer on low heat until it reached a temperature of 175°C-185°C
5. Remove from heat and let it cool to 165°C (needs to thicken to a honey consistency)
6. While cools, grease the inside of a cookie cutter
7. Pour 10ml on the wrapped ball and place the blunt side of the cookie cutter around and apply pressure slowly and the dome will start forming

8. Let the sugar cool and release (leave it while still warm so the plastic is easy to remove
9. Carefully remove the plastic from underneath

Results

The Isomalt dome did not come out as desired. This technique uses thermal expansion, the heat from isomalt was supposed to cause expansion of the air surrounded by the cookie cutter. The process required a few trials however the class came to an end before the desired shape size was achieved.

Conclusion

Developing note-by-note recipes requires time long enough to make several trials. Most of the dishes are adopted from convectional cooking methods and require a deep understanding of the chemistry of various reactions that will take place when compounds are used as replacements.