TU Dublin

Note by Note Report

Advanced Molecular Gastronomy (TFCS9025)

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Contents

Introduction

Food waste [1] is a major challenge we face today. One third of the food produced in the world is wasted along the food chain. This is a critical global problem. According to a United Nations report that was published in 2015, 8.5 billion people will be reached by 2030; this poses a challenge for the global food supply, among others. Therefore, eliminating food waste would go a long way towards alleviating this problem; even good food management could help reduce hunger. However, despite innovation in the area, food waste continues to grow exponentially (Al-Obadi *et al.* 2022). The European Union (EU) demonstrated its concern towards unsustainable food consumption, as the food and drink value chain is responsible for 17% of greenhouse gas emissions and uses 28% of material resources (Bonomi *et al.* 2016). In 2016, the European Commission brought together institutions, experts and stakeholders to create the EU Platform on Food Losses and Food Waste; with the aim of driving efforts towards halving food waste from 2016 to 2030 (European Council, 2022).

Food waste is a significant contributor to eutrophication[2], particularly in areas where it is disposed of in landfills. When food waste decomposes in landfills, it produces methane, a potent greenhouse gas. Additionally, as the food waste breaks down, it releases nitrogen and phosphorus into the environment, which can leach into nearby water bodies, contributing to eutrophication. According to a study by the United Nations Environment Programme, food waste accounts for up to 10% of the total human-generated nitrogen and phosphorus emissions (UNEP, 2013). Gómez and Meneses (2015) conclude that effective management of nutrient inputs is essential for mitigating the negative impacts of eutrophication on aquatic ecosystems.

Due to the huge global impact of food waste, the concept for Note by Note[3] was to challenge the students and contestants to develop a dish based on the concepts of molecular gastronomy [4] and Note by Note with this brief. The aim of this type of cooking is to develop more sustainable food, made from cheaper ingredients, with a longer shelf life and easier to produce. In addition, this requires a

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[1] "The decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers" (IFT, 2020).

[2] Eutrophication sets off a chain reaction in the ecosystem, starting with an overabundance of algae and plants. The excess algae and plant matter eventually decompose, producing large amounts of carbon dioxide. This lowers the pH of seawater, a process known as ocean acidification (NOAA, 2023).

[3] "The concept of note-by-note cooking is to create new dishes by building them from their molecular components, rather than using traditional ingredients like vegetables or meat. In this approach, food is broken down into its chemical compounds, such as proteins, carbohydrates, and lipids, and then these compounds are reassembled in new ways to create unique textures, flavors, and aromas" (This and DeBoise, 2015).

[4] "Molecular gastronomy is an interdisciplinary field of study that combines the sciences with culinary arts to investigate the physical and chemical processes that occur during cooking and the sensory experiences that arise from eating. It aims to understand the behavior of ingredients and the reactions that occur between them during cooking" (Lavelle *et al.* 2021).

deep understanding of food science and the chemical properties of ingredients which is a good educational method for the students of the FIPDes master's degree.

In the case of this report, it has been proposed to develop a cocktail that represents the problem of eutrophication in relation to food waste. The aim of this is to raise consumer awareness. Al-Obadi *et al.* 2022 and Bonomi *et al.* 2016 described the positive impact that this type of social innovation, through consumer education initiatives, has on society. Therefore, it takes advantage of this type of social awareness to develop a cocktail developed through the concepts of Note by Note and molecular gastronomy that represents the problem of eutrophication in the seas due to food waste. It is a cocktail where the ingredients are not mixed as such and have been developed using only pure compounds.

Aim & Objectives

The aim of this work is to develop a cocktail made by means of molecular gastronomy techniques using pure compounds, used in the Note by Note cooking. The aim of this cocktail is to offer the consumer a space for reflection through gastronomy, by means of the sensorial impact of the dish. With the intention of playing an educational role on the problem of food waste, and specifically food waste in the seas and its impact on eutrophication.

Therefore, this paper describes the development of such work; from the precise record of the ingredients used, the amounts needed, and the way they are combined. The cocktail is composed of several parts and follows molecular mixology techniques: it is composed of an edible container (isomaltose sail), the carbonated drink (the carbonated drink), the alcoholic cocktail pod, the ice (ice hand) and extra components that serve as decoration (coral tuile and foam).

The aim of this cocktail is that the isomaltose sail figures the waves of the sea and the foam decoration with the foam and corals made of tuil coral, together with the alcoholic pods with marine shapes, help to represent this visual marine ensemble. However, the ice hand represents the responsibility of humans for food waste in the seas. Therefore, by adding the contents of the carbonated drink (coloured green because it represents the specific problem of the algae responsible for eutrophication[5]) through the empty ice, we see how the sea is impregnated with these algae that pollutes the seas as the responsibility of human action in its responsibility for food waste.

For each of the parts of the cocktail, different molecular gastronomic techniques have been used to compose the different parts of the cocktail and at the

[5] There are several types of algae that can contribute to eutrophication, but some of the most common ones include blue-green algae (also known as cyanobacteria), green algae, and diatoms. These algae can overgrow and accumulate in bodies of water, leading to an increase in nutrient levels, oxygen depletion, and other negative environmental impacts (Boesch, 2002).

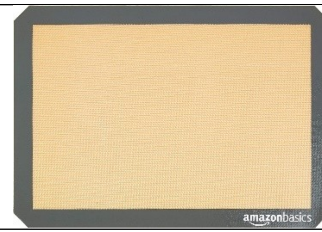
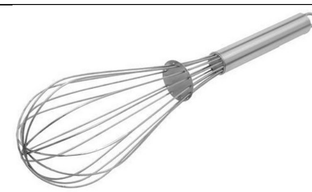
same time, each of them has a specific meaning that helps to transmit the desired message. This cocktail is composed of the following elements, see Table 1:

Element	Technique	Concept
Isomaltose sail	Sugar boiling	The glassware of the cocktail. It represents the waves of the sea.
Coral tuile	Starch Gelatinization	It could be the garnish of the cocktail. It is part of the marine decoration.
Hollow ice hand	Freezing (crystalline lattice structure)	The ice of the cocktail. It symbolises human responsibility for food waste and its effect on eutrophication in the seas.
Alcoholic cocktail pod	Reverse Spherification (molecular mixology)	The base spirit of the drink. It is part of the marine decoration of the cocktail.
Carbonated drink	Carbonation	The mixer of the drink. It represents eutrophication due to the green colour of the algae.
Foam	Foaming	It could be the bitter of the cocktail. Part of the marine decoration.

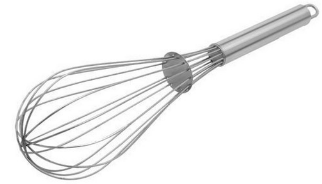
Table 1: Summary of the role of each element in the recipe. *Source: Own elaboration*.

Final Materials & Methods

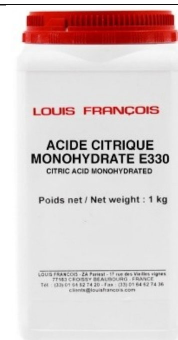
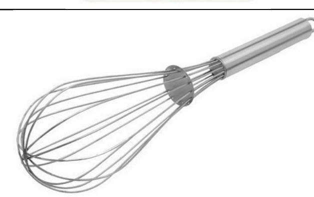
Material	**Role of the ingredient/material**	**Picture**
Isomaltose sail		
Isomalt E953 (DUB 20E)-60g	Main ingredient: structural/flavour	

Silicone mat	Inherent surface that allows us to handle the isomalt and give it the desired shape.	
Saucepan	Vessel for heating and melting the isomalt on the fire.	
Whisker	For mixing the isomaltose when it is warming up.	
Blue colorant (Mallard Ferriere SAS)-0,15g aprox.	It gives the isomaltose the appearance of sea waves.	
Bottle/container or another support	Support for the silicone mat once the isomaltose is in top of it getting hard.	
Coral tuile		
Corn Starch modified (Gem)-20g	It provides structure, texture, and crispness to the finished product.	
Sunflower oil (The King)-10mL	Moisture (without enough moisture, the tuile could become brittle or dry)/crispy texture. Also, for frying.	

Water-30mL	Moisture/binding/texture/ consistency.	Tap water
Green colorant (Apple green-Verde Mela: E102, E133)-3 drops (0,15mL aprox.)	Colour/flavour.	
Hertzon (cis-3-hexenol)-6 drops (0,3mL aprox.)	Flavour.	
Perqoi (hexyl acetate)-3 drops (0,15mL aprox.)	Flavour.	
Citral (3,7-dimethyl-2,6-octodienol)-5 drops (0,25mL aprox.)	Flavour.	
Carvone (L-Carvone)-4 drops (0,2mL aprox.)	Flavour.	

Whisker	Mixing all ingredients together.	
Pan	For frying the mixture.	
Hollow ice hand		
Water	Main ingredient: structure.	Tap water
Freezer	To achieve water freezing.	
Plastic glove	For the support and shape of the ice.	
Mini drill	To make a hole to allow the removal of the inside of the water not yet frozen.	
Alcoholic cocktail pod		
Vodka (Stefanoff Superior 100% pure grain)-50mL	Main ingredient: flavour.	
Water-500mL	The alcohol is diluted.	Tap water

Molds	For getting the shape of the reverse spherification.	
Freezer (-18ºC)	To achieve the shape used with the moulds. Once frozen it helps to create the thin membrane around the liquid in the desired shape.	Coolhead Professional Refrigerator-QR 6
Calcium Lactate (msk)-1,5g	It provides the necessary calcium ions for the spherification reaction and helping to control the texture of the finished spheres.	
Spherification baths		
Water-(500 mL for the sodium alginate bath and other 500 mL for a plain water bath)	It is used both as a solvent in the sodium alginate bath and in a tap water bath to remove any excess sodium alginate and stop the spherification process.	Tap water
Sodium Alginate (msk)-2,5g	To create the gel-like membrane in the presence of calcium ions.	
Slotted spoon	It is used to collect the spherification pod.	
Carbonated drink		
Water-30mL	Mixing solvent (the carbon dioxide gas gets trapped in the liquid, creating carbonation or fizziness in the drink).	Tap water

Green colorant (Il Punto Italiana) Ingredients: Water, maize glucose syrup, sugar, E406 agar, E422 vegetable glycerine, E202 potassium sorbate, E330 citric acid, E102 & E133)-2 drops (0,1mL aprox.)	Colour and flavour.	
Citric acid monohydrated (E330) (Louis Francois)-34,5g	Flavor enhancer and activates baking soda.	
Baking soda (Dr. Oetker)-40,5g	In combination with the citric acid, it produces carbon dioxide gas.	
Caster sugar (Gem)-10,5g	Taste.	
Whisker	Mixing all ingredients together.	
Refrigerator (4,4ºC)	Keeping the sample fresh until be consumed.	Coolhead Professional Refrigerator-QR 6
Foam		

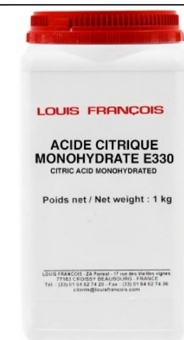
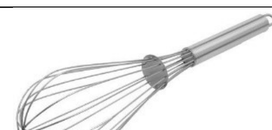
Albumin powder (Sosa)-2g	Stabilizer (helping to hold the air bubbles in place and preventing the foam from collapsing and coalescing).	
Caster sugar (Gem)-50g	Taste/stabilizer.	
Citric acid monohydrated (E330) (Louis Francois)-10g	Stabilizer (regulate the pH and enhance the flavor of the foam).	
Water-200mL	Medium for air to be trapped and held in place by the other ingredients. Also helps to hydrate the proteins in the egg whites, allowing them to unfold and form a stable network of bubbles. It plays a role with texture and consistency.	Tap water
Whisker	Mixing all ingredients together.	
Saucepan	Mixing and heating the glucose and citric acid.	

Table 2: Summary of the role and specifications of each ingredient and material used in the recipe. *Source: Own elaboration.*

Methodology

Isomaltose sail

1. Add the isomaltose to the pot at medium heat.
2. Stir until the powder is dissolved.
3. Once the mixture is boiling, reduce the heat to low and let it simmer for 3-5 minutes.
4. When the mixture reaches a temperature of 160°C. Remove the pot from the heat and carefully pour it onto the silicone mat.
5. Add the blue colorant to the isomaltose for getting the appearance of the sea waves.
6. Place the silicone mat with the isomaltose in the top of a container to be used as a support and we give the desired shape to the silicone mat, as the isomaltose sail will take this shape.
7. Let the sails cool and harden for a few minutes, until they can be carefully lifted off the mat.

This recipe was obtained from This, 2006.

Coral tuile

1. In a bowl, mix the cornstarch and water until well combined.
2. Add the olive oil and mix until fully incorporated.
3. Heat a non-stick pan over medium heat.
4. Spoon a small amount of the mixture onto the pan and spread it out to form a thin circle.
5. Cook the tuile for 1-2 minutes until the edges start to brown and the middle is translucent.
6. Use a spatula to carefully remove the tuile from the pan and shape it into a coral-like form while it's still warm and pliable.
7. Repeat with the remaining mixture.

This recipe was taken from This and Blumenthal, 2006.

Hollow ice hand

1. The glove is filled with water until completely full and closed with a knot.
2. Leave it in the freezer for 1.5 hours.
3. After this time, a hole is drilled in the upper part of the glove and the inside of the water is emptied, leaving an ice in the shape of a hand where the inner part is hollow.
4. The plastic glove is cut and removed from the ice.
5. It is put back in the freezer until further use.

Alcoholic cocktail pod

1. Mix together the vodka, water, and calcium lactate.
2. In a separate bowl, mix together the sodium alginate and water until the sodium alginate has dissolved completely.

3. Pour the vodka mixture into the molds and keep it in the freezer for 2 hours.
4. Take the vodka mixture from the molds and leave them in the sodium alginate bath.
5. Allow the mixture to rest for 5 minutes.
6. Use the slotted spoon to scoop out the spherified pod from the mixture.
7. Rinse the spherified pod with cold water to remove any excess sodium alginate

This recipe is based on one of Elizondo-Salazar and Pimentel-González, 2018.

Carbonated drink

1. In a bowl, combine the water and citric acid. Stir until the citric acid is fully dissolved.
2. In a separate bowl, combine the baking soda and sugar.
3. Slowly add the baking soda mixture to the pitcher of water and citric acid. Stir gently until the mixture starts to fizz and the baking soda is fully dissolved.
4. Add the green colorant.
5. Leave it in the fridge until it would be served.

This recipe was obtained from Ran *et al.* 2021.

Foam

1. In a saucepan, mix the sucrose and citric acid with the water.
2. Heat the mixture over medium heat, stirring constantly, until it reaches 90°C (194°F).
3. Remove the mixture from the heat and add the albumin.
4. Using an immersion blender, blend the mixture until it forms a foam.
5. Let the foam rest for a few minutes before using.

This recipe was taken from This, 2006.

Results & Discussion

Figures 1, 2 and 3 show the finished results of the cocktail from different angles. The results correspond to what was expected. Each of these results is discussed in more detail below.

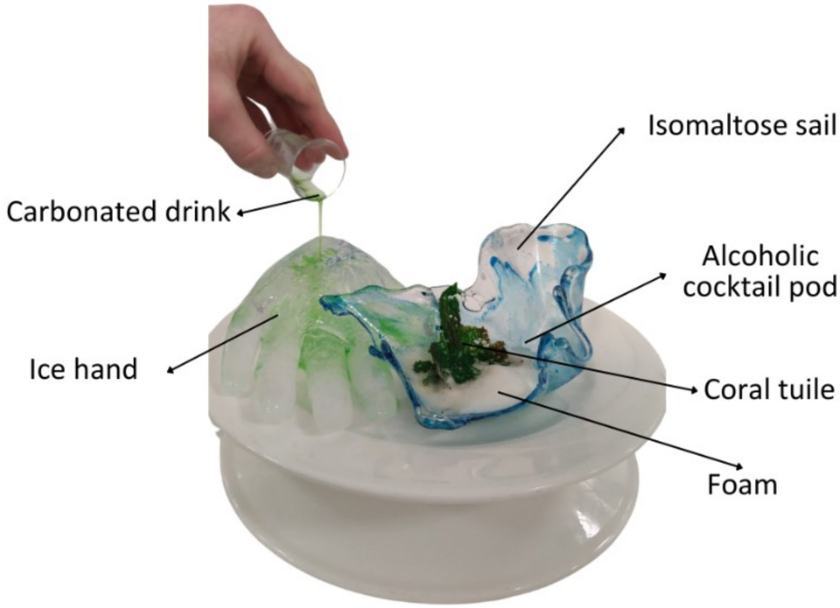


Figure 1: Final presentation by adding the carbonated drink to the ice. *Source: Own elaboration.*

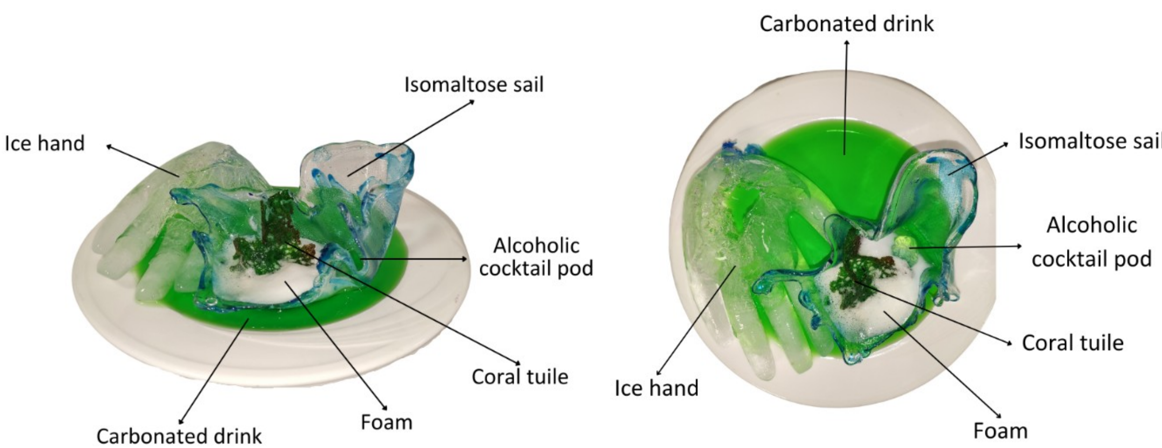


Figure 2: Final presentation with the drink already added. (Left: front view, right: view from above). *Source: Own elaboration.*

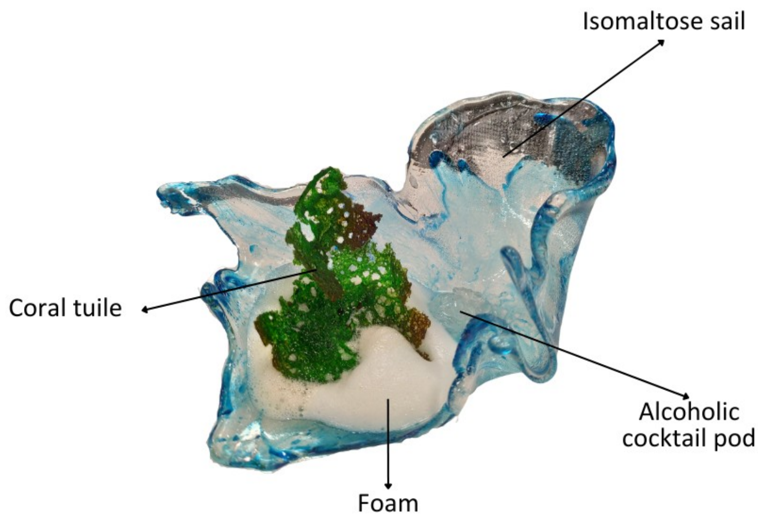


Figure 3: Final presentation without the ice and carbonated beverage. *Source: Own elaboration.*

For the discussion of these results, we will analyse the role of each ingredient in each of the cocktail elements, as shown below.

In the case of the isomaltose sail, a sail with a transparent appearance and a stable crystal-like texture was obtained, see Figure 4. In addition, the blue colouring gave it an appearance like that of sea waves. Clearly, its taste is purely sweet as it is isomaltose (disaccharide). However, it was certainly sensitive to heat and was also slightly brittle. The recipe published by This, 2006 was followed. This explains that isomaltose is formed during sugar inversion as a by-product of the reaction. Sugar inversion refers to the process in which sucrose is hydrolysed into glucose and fructose (its monosaccharides), which are sweeter and more soluble than sucrose. Isomaltose is a disaccharide consisting of two glucose molecules linked together. It is less sweet than sucrose but more soluble in water. This makes it useful in some food applications because of its resistance to hydrolysis and its ability to form a glassy state when rapidly cooled (This, 2006). In addition, there are several parameters that affect the structure and state of the isomaltose candle. These are sugar concentration, cooling rate and drying temperature (Wu *et al.* 2016). Wu et al. (2016) found that increasing sugar concentration resulted in candles with higher mechanical strength and lower water content, while faster cooling rates and lower drying temperatures resulted in candles with better transparency and lower porosity (This, 2007).

Figure 4: Final result of the isomaltose sail. *Source: Own elaboration.*

In the case of the coral tuile, a kind of thin, crisp biscuit resembling a piece of coral was obtained, see Figure 5. Its flavour was mainly marked by the Green colorant (Il Punto Italiana) which gave it an apple flavour and the taste of the oil. Even so, aromatic notes from the other flavourings, which contributed herbal, citrus, fruity (pear and apple) and menthol flavour notes, could hardly be perceived; it would be necessary to add more of these and less of the pear-flavored green colourant. Here, starch is the main ingredient and once heated in excess water, it undergoes a ggelatinizationprocess. This is described as "a non-equilibrium process dependent on high energy input that leads to the collapse of the native semi-crystalline orders of lamellae into starch granules" (Lavelle *et al.* 2021). During the process of coral tuile development, the granules absorb water and the typical gelatinous texture that appears during FOTO processing is obtained. When it reaches 100°C, the starch changes from a semi-crystalline to an amorphous state. In addition, the water evaporates and the bubbles that give a certain porous aspect characteristic of coral tuile appear; a, andat drier and crunchier texture begins to appear. Regarding the role of the oil, sunflower oil was used rather than another vegetable source because of the taste, as sunflower oil is milder than olive oil, for example. In addition, the oil helps to stastabilizee gas cells by coating the gas cells and preventing them from coalescing. This is because it creates a crystal-water interface developed by the fat crystals, which are then adsorbed to the gas-liquid interface of the bubbles. Thus, the interface surrounding the fat crystals merges with the gas-liquid interface of the bubble (Brooker, 1996). Oil was also used to cook the coral tuile. The other ingredients were purely for flavouring.

Figure 5: (Left: Cooked tuile coral with a viscous texture in the centre and slight bubbling on the outside). (Right: Final result of the isomaltose sail). *Source: Own elaboration.*

For the development of the hollow ice hand, a similar methodology was considered as when it was developed using gelation, see Figure 6. A hollow ice was developed on the inside, although due to transport to the university, it was more brittle and ended up breaking slightly. As described by Akyurt *et al.* 2002, ice is considered a brittle material because it fractures easily under stress and voids form between crystals. The temperature of each part of the structure was taken into account in the development of this technique. The surface, being directly in contact with cold air, acquires lower temperatures and reaches the freezing state earlier than the centre of the structure, which is at a higher temperature. It is key to control the time in relation to the temperature; to, at the right moment, slightly perforate the base and remove the interior of the water that has not yet reached the frozen state. This ice surface has unique properties in that near the melting point, it has broken dangling bonds that promote the existence of a liquid-like layer.

Figure 6: Final result of the ice hand (left: ice still with glove on; right: ice ready without glove). *Source: Own elaboration.*

Figure 7 shows a schematic of the physico-chemical processes that occur during freezing. ABCDE are related to pure water. The first event produced is subcooling, which is below the freezing point Tf and is a non-equilibrium metastable state. Water can be subcooled several degrees before nucleation begins. Once the critical mass is reached at the nuclei, the system undergoes nucleation at point B and releases latent heat at a faster rate than the heat extracted from the system when it is in the aqueous state. Instantly, the temperature rises to the initial freezing temperature (Tf, point C). The timeline from C to D represents the time during which crystal growth occurs and the partially frozen mixture will not cool until all the water has crystallised (line CD occurs at constant temperature). Therefore, the freezing time (tf) is defined as the time from the onset of nucleation (C) to the complete removal of latent heat (D). Once crystallisation is complete, the temperature drops from D to E as sensible heat is released. Finally, it is worth noting that the behavior of water is special, and that unlike other substances that become denser as they cool, the opposite is true for water. In addition, this ice structure becomes transparent to visible light because it has a very low refractive index. (Akyurt *et al.* 2002).

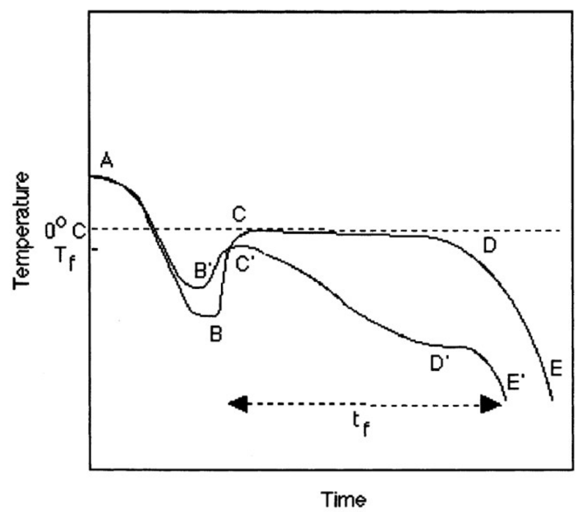


Figure 7: The process of water crystallization. *Souce: Akyurt et al. 2002.*

Regarding the alcoholic pods, the desired shape provided by the moulds was not obtained and this may be due to insufficient time in the freezer, which was approximately one hour. However, the esterification of the alcoholic pod was achieved, see Figure 8. This resulted in a gelatinous layer on the surface and the alcohol/water mixture inside. This spherification technique involves the development of spheres of liquid consistency encapsulated in a thin gelatinous layer of hydrocolloid. Sodium alginate is a hydrocolloid (composed of sugar components: b-D-mannuronic and a-L-guluronic acids that are linked by glycosidic bonds in linear configurations) that acts gelling, and calcium is a divalent metal ion necessary in this formulation; since this gelling process occurs when the hydrocolloid, which is a complex carbohydrate, get a divalent calcium ion and a crosslinking of the sugar strands is formed. It should be noted that the most important property of the alginate in the spherification process is that of charging the carbohydrate units. This crosslinking induces a phase change of the alginate from a viscous liquid to a solid form. Specifically, in this case, a reverse spherification has been developed, where calcium (calcium lactate) is added to the liquid (vodka and water) and encapsulated by the hydrocolloid membrane, as the liquid is immersed in the hydrocolloid bath with sodium alginate. In this case, calcium lactate was used, as it has a neutral taste, as opposed to calcium chloride, which has a salty taste. In the alginate bath, calcium will move from the liquid to the alginate layer on the surface of the sphere (Lavelle *et al.* 2021). Arbaan *et al.* 2020 and Lavelle *et al.* 2021 have highlighted the relevance of this technique in relation to the development of edible water bottles that would contribute to reducing the environmental impact of plastic. In addition to reducing the problem of Bisphenol A (BPA) in the human body, which is a problem for pregnant women's placentas and growing fetuses, and which was found in 96% of women in a study carried out in the U.S. It is therefore an ideal technique for the development of this work, contributing to its subject matter.

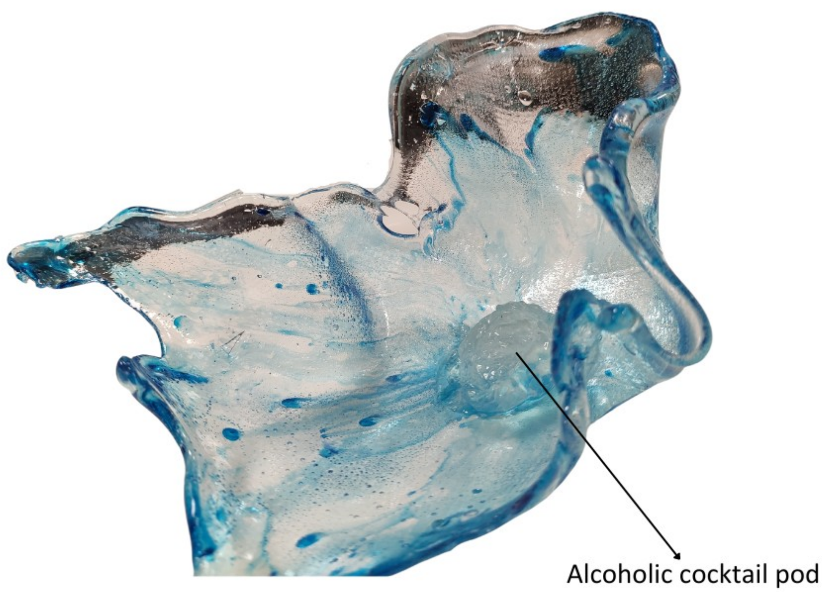


Figure 8: Final result of the isomaltose sail and alcoholic cocktail pod. *Source: Own elaboration.*

The green carbonated beverage lived up to expectations. It had a green colour similar to seaweed, some fizziness that provided a pleasant texture and taste in the mouth, and a citric flavour typical of a lemon-based drink, see Figure 9. The reaction between an acidic source (citric acid in this case) and bicarbonate compounds or their salts (sodium bicarbonate in this example), produce carbon dioxide gas (CO_2) when they meet water. This released CO_2 provides a fresh mouthfeel. In the case of the use of citric acid, it has advantages over other acids due to its solubility in water; it also provides a characteristic sour taste that makes it quite acceptable. Sodium bicarbonate also dissolves completely in water, is not hygroscopic and can be safely consumed. Citric acid is hygroscopic and an increase in citric acid would make the particle size larger, also increasing the moisture content. It is the citric acid that determines the particle size, the moisture content of the granules and the flow characteristics of the beverage. In addition, the ratio of sodium bicarbonate to citric acid has a significant impact on bubble characteristics such as pH, sensory acceptance and dispersion time. This ratio is key in determining the characteristics of these effervescent granules (Ran *et al.* 2021). According to Ran *et al.* 2021, the best sodium bicarbonate/citric acid ratio is 6:7, being the most acceptable in terms of taste, aroma, texture and colour compared to others. The dispersion time of the effervescent granules for this formulation was <5 minutes and the pH had a value of 5,74±0,01. The sugar in the formulation also plays a relevant role in affecting the organoleptic profile (taste and odour), microbial and temperature stability and solubility (Reidah and Ibrahim, 2020). Green colorant (Il Punto Italiana) provided characteristic colour and flavour to the beverage.

Figure 9: Final result with the carbonated drink (without the ice hand). *Source: Own elaboration.*

In the case of the foam, an airy consistency was obtained, white in colour and with a slightly acidic taste, see Figure 10. The predominant phase in the foam is the air phase. However, its microstructure depends on the composition and balance between ingredients. This process takes place in two stages, the whipping and building of the structure, and the draining of the foam. Heat treatment allows them stabilizes the structure by converting the foam from liquid to solid. The concentration of citric acid and sugar plays a key role in the formation of the meringue structure, as low sugar/EW (egg white protein: albumin) ratios and high levels of citric acid led to an increase in the average pore size and thus to higher porosity. In addition, sucrose has been shown to contribute to the brittleness and hardness of the foam, just as citric acid contributes to softer foams. The quality of the albumin also proves to be relevant in the processing of these foams (Licciardello *et al.* 2012). Foams are a dispersed system of air bubbles trapped in a liquid phase, therefore whisking is important for droplets to be small and stable in the emulsion (Lavelle *et al.* 2021).

Figure 10: Final result of the foam. *Source: Own elaboration.*

Conclusions

In this report, a cocktail was developed following molecular mixology and gastronomy techniques and using only pure compounds from Note by Note cooking. In addition, the dish presented has a role to play in raising awareness and social education about the problem of food waste in the seas, due to its impact on eutrophication. This means that the dish becomes a space that invites the consumer to reflect and environmental awareness in addition to the gastronomic and visual enjoyment of it.

Each element of the dish was created using different molecular gastronomy techniques that would allow a greater understanding of the food science behind the food matrix; in addition to being in accordance with the element that was to be represented so that as a whole it could transmit the desired idea. The isomaltose sail is the glassware of the cocktail, it represents the waves of the sea and its main scientific principle is that of sugar boiling; the coral tuile is the garnish of the cocktail, it is part of the marine decoration and its development is explained through starch gelatinization; the hollow ice hand is the cocktail ice, it symbolises human responsibility over food waste and its main principle is that of the different states of water by controlling the temperature and time of the different parts of the structure; the alcoholic pod is part of the spirit base of the cocktail and was made by reverse spherification; the carbonated drink is part of the mixer, it represents the algae of eutrophication and the scientific principle behind it is that of carbonation which is released due to the presence of sodium bicarbonate and citric acid in water; and finally, the foam is the bitter of the cocktail, it is part of the marine decoration and was developed by understanding the chemical principles of foaming.

References

Akyurt, M., Zaki, G. and Habeebullah, B. (2002). *Freezing phenomena in ice–water systems.* Energy conversion and management, 43(14), 1773-1789.

Al-Obadi M., Ayad H., Pokharel S. and Arselene M. (2022). *Perspectives on food waste management: Prevention and social innovations*. Sustainable Production and Consumption, Volume 31, Pages 190-208, ISSN 2352-5509.

Arbaan, N., Chek, W., Yusuf, N. and Khairuzzaman, S. (2020). *Edible Water Blobs*. International Innovation Competition (INNOCOM) 140.

American Chemical Society. (2020). *Homemade Carbonated Beverages.* [Accessed March 2023]. Available at: https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/2019-2020/december-2019/homemade-carbonated-beverages.html

Brooker B. (1996). *The Role of Fat in the Stabilisation of Gas Cells in Bread Dough*. Journal of Cereal Science, Volume 24, Issue 3. Pages 187-198. ISSN 0733-5210.

Boesch, D. (2002). *Eutrophication: causes, consequences, and controls in aquatic ecosystems.* Science, 296(5576), 1068-1071.

Bonomi, S., Moggi, S., Ricciardi, F. (2016). *Innovation for sustainable development by educating the local community. The case of an Italian project of food waste prevention.* In: International Conference on Exploring Services Science, 247. Springer, Cham, pp. 705–716

Elizondo-Salazar, J., & Pimentel-González, D. (2018). *Reverse spherification: a novel technique for the elaboration of functional foods.* Journal of Food Science and Technology, 55(4), 1331-1338.

European Council. (2022) *Reducing food loss and food waste.* [Accessed May 2023]. Available at: https://www.consilium.europa.eu/en/policies/food-losses-waste/

Gómez, B., & Meneses, M. (2015). Eutrophication: An ecological vision of the problem. Revista de Investigación Académica, 27, 1-11.

IFT. Institute of Food Science and Technology. (2020). *Food waste*. [Accessed April 2023]. Available at: https://www.ifst.org/resources/information-statements/food-waste#:~:text=Food%20waste%20(FAO)%3A%20%E2%80%9C,Waste%20Destinations%20listed%20%5Bhere%5D.

Lavelle C., This H., Kelly A. and Burke R. (2021). *Handbook of Molecular Gastronomy: Scientific Foundations, Educational Practices, and Culinary Applications.* ProQuest Ebook Central. Online edition. [Accessed April 2023] Available at: https://ebookcentral.proquest.com/lib/dublinit/detail.action?docID=6562662.

Licciardello, F., Frisullo, P., Laverse, J., Muratore, G. and Del Nobile, M. A. (2012). *Effect of sugar, citric acid and egg white type on the microstructural and mechanical properties of meringues.* Journal of Food Engineering, 108(3), 453-462.

Nirav B., Jatin P., Dhruvkunar S., Gopal R. and Viral S. (2019). *Agar-Agar bioplastic synthesis and its characterization.* International Journal of Emerging Technologies and Innovative Research. ISSN:2349-5162, Vol.6, Issue 3, page no.338-344.

NOAA (National Oceanic and Atmospheric Administration). (2023). *What is eutrophication?* [Accessed April 2023]. Available at: https://oceanservice.noaa.gov/facts/eutrophication.html#:~:text=Eutrophication%20sets%20off%20a%20chain,process%20known%20as%20ocean%20acidification.

Ran, K., Parfati N., Jayani N., Kurniawan I., & Kristiani N. (2021). *The development of Moringa leaves effervescent granules with effervescent agent of citric acid and sodium bicarbonate*. Pharmaciana, 11(2), 225-240.

Reidah A. and Ibrahim M. (2020). *Trends in Non-alcoholic Beverages*. Carbonated Beverages. 1–36.

Siew L., Hii L., Jia-Yee O., Wan-Teck W. and Ching L. (2016). *Agar from malaysian red seaweed as potential material for synthesis of bioplastic film.* Journal of Engineering Science and Technology. 11. 1-15.

This, H. and Blumenthal, H. (2006) *Molecular Gastronomy: Exploring the Science of Flavor.* California: University of California Press

This, H. (2007). *Kitchen Mysteries: Revealing the Science of Cooking*. Columbia University Press. ProQuest Ebook Central. [Accessed April 2023]. Available at: https://ebookcentral.proquest.com/lib/dublinit/detail.action?docID=908201.

United Nations Environment Programme. (2013). *Waste to wealth: The circular economy advantage*. [Accessed April 2023]. Available at: https://www.unenvironment.org/resources/report/waste-wealth-circular-economy-advantage

This H. and DeBevoise M. (2015). *Note-by-Note Cooking: The Future of Food*. New York. Columbia Scholarship Online. Online edition. [Accessed April 2023] Available at: https://academic.oup.com/columbia-scholarship-online/book/20248

Wu, L., Zhang, J., Zhang, X., & Sun, W. (2016). Effects of process parameters on the properties of isomaltose sails. Journal of Food Engineering, 191, 66-74

Logbooks

Logbook 1

MODULE CODE: TFPD9022

MODULE TITLE: Food Prototype Development and Evaluation

STUDENT NAME: Silvia Fernández Fernández

FOOD PRODUCT: Note by Note

WEEK NO.: 9 **DATE: 20/03/2023**

Weekly Aims and Objectives

- Development of an edible hand, made from what could mimic bioplastic.
- The development of the hand would serve as a base to place the rest of the dish on top of it.
- The intention of having it in the shape of a hand is to teach the consumer a lesson that food waste is in our hands, it is our responsibility.

Materials and Method (Ingredients, Equipment and Method)

<u>Ingredients</u>

- Agar-agar powder 20g
- Glycerine 30mL
- Gelatine powder 3g
- Food red coloring (concentrated gel), Few drops
    - Sugar
    - Glucose syrup
    - Water
    - E422

- E406
- E330
- E202

- Water 800mL
- Phenethyl alcohol (Flose), Few drops
- Plastic glove

Equipment

- Pot
- Whisker

Method

1. Add 800mL of tap water.
2. Mix the agar-agar and gelatine powder and add them with the water.
3. Stir everything until the solution becomes slightly vicious.
4. Add the glycerine to the mix, gradually and stirring.

Figure 11: Stirring of the mixture being heated in the pot.

5. Add the colour and aroma (phenethyl alcohol) to the mix.
6. Let it cool a little.
7. Fill a plastic glove with the mix and let it cool in the fridge for 2/3 days.
8. The glove is cut and the hand shape with our mixture is ready.

Results and discussion

An image of the bioplastic material hand is shown in Figure 12 below.

Figure 12: Bioplastic hand on glove already gelled.

A gel with a red colour and a natural floral flavour was developed. Each ingredient had a specific role in the formation of the gel. Water acts as a solvent to dissolve and stay disrupted after heating, glycerine acts as a plasticizer because it lubricates the plastic and makes the bioplastic more flexible, agar and gelatine powder are used as a thickening agent and the food coloring is to give attractive colour and decoration, as well as the aroma (Nirav B*. et al.* 2019).

Conclusions

A gel was developed with a typical bioplastic formulation with a red colour and a floral flavour.

Recommendations for following week.

In the end, this gel was not used for the prototype of the final idea because the concept was changed.

Logbook 2

MODULE CODE: TFPD9022

MODULE TITLE: Food Prototype Development and Evaluation

STUDENT NAME: Silvia Fernández Fernández

FOOD PRODUCT: Note by Note

WEEK NO.: 10 **DATE: 27/03/2023**

Weekly Aims and Objectives

As class attendance was not possible this day, it was proposed to develop something possible to do at home and alternative to what had been done the previous week but that could be used in the final idea. Therefore, following the idea of the cocktail, it was decided to create a hand-shaped ice cube with a hollow inside that could be filled with the soft drink. The intention of this is to play with the freezing point of the ice and take advantage of the moment when only the outer, colder layer freezes, while the inner layer remains liquid and can be emptied, creating a hollow ice.

Materials and Method (Ingredients, Equipment and Method)

Ingredients

- Water
- Plastic glove
- Mini screwdriver (for drilling a hole in the ice)

Equipment

- Freezer

Method

6. The glove is filled with water until completely full and closed with a knot.
7. Leave it in the freezer for 1.5 hours.
8. After this time, a hole is drilled in the upper part of the glove and the inside of the water is emptied, leaving an ice in the shape of a hand where the inner part is hollow.
9. The plastic glove is cut and removed from the ice.
10. It is put back in the freezer until further use.

Results and discussion

Figures 17 and 18 show the result of the appearance of the ice, with and without the glove attached.

Figure 17: Ice in the shape of a hand, hollow and still with glove attached.

Figure 18: Final result of the hollow ice.

Conclusions

A hollow hand-shaped ice was developed that would form part of the ice part of the cocktail. This was done by controlling the freezing point of the water over time and temperature, where the surface reaches a lower temperature earlier than the inside because it is part of the contact surface with the cold air in the freezer.

Recommendations for following week.

The following week will see the development of the isomalt-based cocktail packaging, which will represent the sea, and the sea coral decoration, which will represent part of the corals and algae present in the sea.

Logbook 3

MODULE CODE: TFPD9022

MODULE TITLE: Food Prototype Development and Evaluation

STUDENT NAME: Silvia Fernández Fernández

FOOD PRODUCT: Note by Note

WEEK NO.: 11 **DATE: 17/04/2023**

Weekly Aims and Objectives

- Development of an isomaltose sail that will form part of the cocktail glass and represent the sea. It will be decorated with blue colouring to obtain this visual effect.
- Development of green tuile coral that will be part of the marine decoration.

Materials and Method (Ingredients, Equipment and Method)

For the isomaltose sail:

Ingredients

- Isomaltose
- Blue colorant

Equipment

- Pot
- Silicone mat
- Bottle (or something for holding the silicone mat with the isomaltose)

Method

1. Place the isomaltose in a pot at low-medium heat and stir until it is melted.
2. Once it is melted, place it in the silicone mat and add some blue colorant for decoration.
3. Place the silicone mat with the isomaltose in top of a bottle (making the desired shape) and hold it there for 5 minutes until the isomaltose is dry and hard.
4. Carefully, remove the isomaltose sail from the silicone mat.

Figure 13: Appearance of isomalt when not yet heated.

For the coral tuile:

Ingredients

- Starch
- Olive oil

- Water
- Green colorant

<u>Equipment</u>

- Whisker
- Pan
- Spoon

<u>Method</u>

1. Mix everything.
2. Put a little bit of olive oil in the pan for cooking the tuile at medium heat.
3. With a spoon, put some of the mixing in the pan and cook it until the tuile is crispy.

Figure 14: Appearance of tuile coral while being cooked.

Results and discussion

Figure 15 and 16 show the results for isomaltose sail and coral tuile. Both performed well, as expected.

Figure 15: Result of the isomaltose sail.

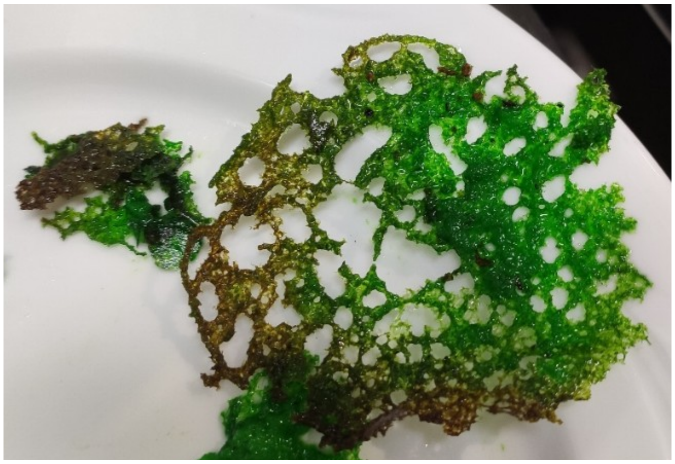


Figure 16: Result of tuile coral.

Conclusions

Good results were shown for both elements of the cocktail. The tuile coral had a crisp, green-coloured texture that simulates elements of marine corals. In contrast, the isomaltose sail had a translucent and hard appearance with a blue design representing the sea.

Recommendations for following week.

Continue with the development of the rest of the cocktail elements.

Logbook 4

See Results and Discussion. During this day, the cocktail presentation took place, so everything that was done is described above.