Technological University Dublin

Advanced Molecular Gastronomy TFCS9025

The Development of a Note-by-Note Dish

FIPDes Student

Bogdan Dinić

D21127083

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Contents

Introduction

Molecular gastronomy was invented by Herve This in 1988 (Burke, Danaher and Hurley, 2020), which he defines as a scientific field *'searching for the phenomena mechanisms happening during preparation and consumption of dishes'* (This, 2003). In 1994, a new discipline, Note-by-note cooking was proposed by the scientist, where only pure compounds would be used. (Burke, Danaher and Hurley, 2020). As Herve This stated in the name of his paper: *'Molecular Gastronomy is a Scientific Discipline, and Note by Note Cuisine is the Next Culinary Trend'* (This, 2013).

For the class in molecular gastronomy currently conducted at TU Dublin, students had to make a note-by-note dish for a competition being held in Paris in September 2022. My initial idea was to create the pixel art pizza slice, reconceptualizing one of the most well-known foods in the world. Small cubes with different characteristics were supposed to be arranged in a shape of a pizza slice. This was supposed to create intrigue and a positive response from the people trying the meal, showing the capabilities and "the magic" of note-by-note. Cubes were meant to be all same in size, but with different textures and flavours: jelly mozzarella-like cheese cubes, crispy bacon cubes and crunchy pizza crust cubes. After conducting research, recipes for different cubes were inspired by varying sources: the texture for the bacon cubes was inspired by the professor Róisín M. Burke's recipe for 3D lobster (Burke et al., 2021), and the idea of creating pizza crust cubes came to mind after reading the bread grissini recipe of Andrea Camastra (Burke et al., 2021), while cheese cubes took inspiration from multiple recipes with agar and xanthan (Lersch, 2014).

As the classes progressed, the idea evolved. Due to the lack of time to realize the idea, the infeasibility to create the product in that short time span or the weekly change in the available ingredients and the lack of them, the meal had undergone a decent number of changes from the original concept. All this culminated that for the competition we have a pixel art pizza slice but **pizza – redefined**: a meal of tomato and bacon spaghetti accompanied with cheese and smoky cubes. These changes beautifully represent the ideas behind cooking, science and molecular gastronomy: adaptation, observation, research and finally innovation!

Aim of the assignment

This report aims to present all the steps that were made during the formulation of this dish, along with the sensory evaluation of the finalized recipe and the subsequent analysis of the received results.

Final Materials and Methods

During the experiments, the following equipment was used:

- An Oven (Electrolux)
- A Stove (Electrolux)
- A Freezer (Sogi)
- Plastic trays
- Digital pocket scale (Triton T3, 0,01 g graduation)
- Digital kitchen scale (Soehnle, 1 g graduation)
- Stainless steel bowls
- Whisk
- Pots
- Spoons
- Forks
- Knife
- Ladle spoon
- Plastic moulds for cubes shape (mini-ice cubes mound 1cm x 1cm x 1cm, Yantan)
- A syringe of 50 ml (Special Ingredients)
- Silicone tubing 0.5cm inner diameter (Special Ingredients)

Figure 1: Plastic moulds for cubes

For the final recipe, the quantities of the ingredients are marked in the tables below, with the names of the suppliers mentioned in the brackets next to the ingredient:

Cheese cubes		
Ingredient	Unit	Quantity
Water	g	200
Dietary fibre cellulose (NutnCology)	g	14
Salt	g	2
Sugar (sucrose replacement)	g	3
Food colouring – yellow (Il punto Italiana)	g	0.15
Pure compound – Berthome (Iqemusu)	g	0.15
Cheese flavour – cheddar powder (Sosa)	g	6
Agar (Sosa)	g	1.87
Xanthan gum (Sosa)	g	0.5

Table 1: Cheese cubes recipe

Bacon (smokey) cubes		
Ingredient	Unit	Quantity
Cornflour (starch replacement)	g	66
Olive oil (oleic acid replacement)	g	14
Water	g	120
Dietary fibre cellulose (NutnCology)	g	14
Sugar (sucrose replacement)	g	2
Food colouring – green (Il punto Italiana)	g	0.1
Food colouring – red (Il punto Italiana)	g	0.1
Food colouring – blue (Il punto Italiana)	g	0.05
Flavour – Smokey bacon (MSK flavours)	g	0.1
Flavour – Pork back (Sosa)	g	0.05

Table 2: Bacon cubes recipe

Tomato spaghetti		
Ingredient	Unit	Quantity
Water	g	150
Dietary fibre cellulose (NutnCology)	g	8
Agar (Sosa)	g	1.5
Sugar (Sucrose replacement)	g	2
Salt	g	1
Tomato powder flavouring (Sosa)	g	4.5
Ripe tomato flavour (Sosa)	g	0.1
Vegetable flavour (Sosa)	g	0.05
Lactic acid (Essedielle)	g	1
Food colouring – red (Il punto Italiana)	g	0.1

Table 3: Tomato spaghetti recipe

Bacon spaghetti		
Ingredient	Unit	Quantity
Water	g	150
Dietary fibre cellulose (NutnCology)	g	8
Sugar (Sucrose replacement)	g	3
Salt	g	2
Agar	g	1.5
Food colouring – green (Il punto Italiana)	g	0.1
Food colouring – red (Il punto Italiana)	g	0.1
Food colouring – blue (Il punto Italiana)	g	0.05
Flavour – Smokey bacon (MSK flavours)	g	0.05
Flavour – Frankfurt sausage (Sosa)	g	0.05
Flavour – Pork back (Sosa)	g	0.05

Table 4: Bacon spaghetti recipe

Method for the cheese cubes: All the ingredients were measured in separate bowls or plastic trays. Powered ingredients were put in the bowl with the water after which there was intensive whisking for 30 seconds. The mixture was transferred to a pot, put on the stove, and turned on the medium-high fire. The mixture was whisked constantly until the water starts to

boil, when it was removed from the stove, whisked intensely for two more minutes after which was transferred to the mould. Mould was put into the freezer at -17°C for 20 minutes so the solution thickens. Cubes were taken out of the mould and put on the plate while they were still cold.

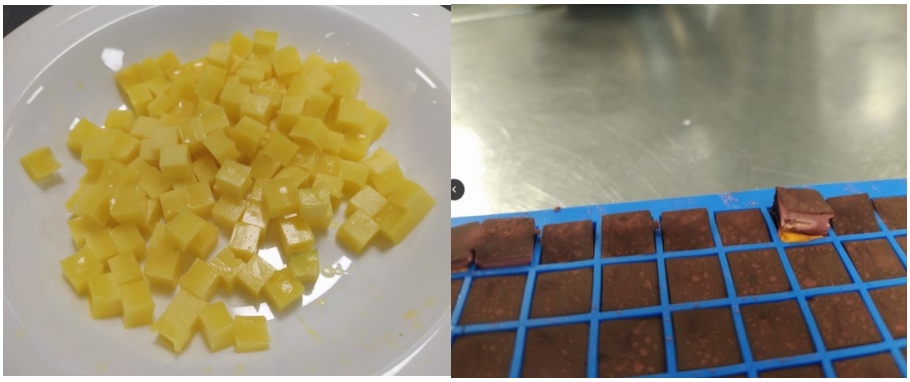
Method for the tomato spaghetti: All the ingredients were measured in separate bowls or plastic trays. The lactic acid was added to the water and whisked until it was spread evenly. Colour was added and whisked until the colour was uniform, after which the powdered ingredients were added. The mixture was put in the pot and set on the stove on medium-high fire. The mixture was whisked until it boiled, after which t was removed from the stove while being whisked for 2 more minutes. One big bowl was filled with cold water used to cool the mixture. The syringe was filled with the mixture and then the silicone tubing was attached to the syringe. The content of the syringe was blown out through the tubing until the whole tubing was filled with the mixture, after which the syringe was detached. The tubing was submerged below the water except for the last five centimetres from both sides. The tubing with the mixture was left to cool down for one minute, after which a clean syringe was used to blow out the “spaghetti” from the tubing.

Method for the bacon spaghetti: All the ingredients were measured in separate bowls or plastic trays. Colour was added and whisked until the colour was uniform, after which the powdered ingredients were added. The mixture was put in the pot and set on the stove on medium-high fire. The mixture was whisked until it boiled, after which t was removed from the stove while being whisked for 2 more minutes. One big bowl was filled with cold water used to cool the mixture. The syringe was filled with the mixture and then the silicone tubing was attached to the syringe. The content of the syringe was blown out through the tubing until the whole tubing was filled with the mixture, after which the syringe was detached. The tubing was submerged below the water except for the last five centimetres from both sides. The tubing with the mixture was left to cool down for one minute, after which a clean syringe was used to blow out the “spaghetti” from the tubing.

Method for the bacon cubes: All powdered ingredients were measured and mixed in a big stainless bowl. In the second bowl, the water and water-soluble food colouring was added, after which the flavours and the oil were added. The content was mixed until the colour and oil were uniformly spread. After this, the content of the second bowl was added to the powdered ingredients and whisked until the "mass" was uniform. The mixture was poured down into the mould and put in the oven at 160°C for 7 minutes. The cubes were taken out of the mould and onto the baking tray covered with parchment paper, rotated upside down from the original position, and baked for 13 additional minutes at 160°C.

Results

The prepared parts of the dish were all arranged on a plate that was considered the most aesthetically pleasing, after which the pictures were taken for the competition. The picture of the parts of the dish and the final dish assembled are presented in the figures below.



Figures 2 and 3: Cheese cubes (left) and bacon (smoky) cubes (right)

Figure 4: Tomato and bacon spaghetti

*Figure 5: Complete **pizza – redefined** dish*

After this, a last-minute announced sensory evaluation was conducted. Due to the short period and the fact that everyone was trying to do the sensory evaluation at the same time, there were only seven participants. The sensory evaluation was conducted in an informal manner, with people being asked to rate five characteristics: general appearance, colour, texture, taste, the general likeness of the meal, and the flavour of the different parts of the meal that resembles the original (for example, whether the cheese cubes taste like cheese, or does the tomato spaghetti taste like spaghetti etc.). For the sensory, a 9-point hedonic scale was used, as they are the best for measuring preference/liking (Barbosa-Cánovas, 2009), with the following division: 1 - Dislike extremely; 2 - Very much dislike; 3 – Moderately dislike; 4 – Slightly dislike; 5 -Indifferent; 6 – Slightly like; 7 – Moderately like; 8 – Very much like; and 9 – Extremely like. The consumers tasted the product and gave verbal responses.

The analysed results are presented in Table 5:

Sample 647					
General appearance	Colour	Texture	Taste	General likeness	Flavour resemblance
6.71	7.14	4.86	5.29	5.43	7.29

Table 5: Sensory analysis result

Standard deviation					
General appearance	Colour	Texture	Taste	General likeness	Flavour resemblance
1.16	0.99	1.25	0.88	1.29	0.88

Table 6: Standard deviation of the questions asked in Table 5

Research suggests that the mean score of seven or above on the nine-point hedonic scale means that the product has well accepted sensory qualities (Barbosa-Cánovas, 2009). A product with these characteristics could be marked as reaching the "target quality". As we can see, the product has reached the target this result in two categories; "colour" and "flavour resemblance" with the third category of "general appearance" being nearby. The other three categories: "texture", "taste" and "general likeness" received the results which means are closest to the answer indifferent.

Figure 6: Graphical representation of the sensory evaluation results

As for the standard deviation for the answers provided, we can see that the best-rated characteristics of the meal are also the ones that have the most uniform answers, alongside the taste. The two categories that had the answers that were polarised the most were also the categories that weren't rated the best. Respondents also added a few verbal comments as: "I like the cheese cubes", "Looks colourful and funny, would like for it to be a sweet dish!", "It was ok" and "I am not a fan of jelly food".

Discussion

Looking at the results received from the sensory evaluation, I have to admit I am not satisfied. Looking at the results, it is obvious that the texture was the key problem regarding this meal, as it greatly affects the perception of taste and general likeness, the other two categories were rated as the worst alongside the texture. This can also be shown through the results of the sensory evaluation. If we look at the flavour resemblance of the individual meal pieces to the products they were trying to replicate, we can see that it was very well marked, scoring the highest from all the six categories. Looking at the results on taste, we have a drop of almost two points and a significant difference between these two characteristics. What is also interesting is that the standard deviation was the smallest for these two categories (0.88) which means that the people were least likely to give an answer that is significantly different from the mean of the responses. A connection between these two characteristics is the texture, which received the worst mean score.

After thinking about what the problem could be, I believe that this is influenced by having too many "jelly" pieces on the plate: the two types of spaghetti and the cheese cubes on the side, all of which used the basis of agar. This might also explain why the preference for the individual pieces was higher than for the whole meal. Even if the pieces are good on their own, eating multiple pieces that have different shapes, colours, and flavours but feel in the mouth the same way, might underwhelm the expectation of the consumer making him give a lower mark. The "smoky" (bacon) cubes were trying to provide that crunchiness and the difference in the texture. Even though they were supposed to have the bacon flavour with a slight note of smoke, the smoke note from the MSK Smokey Bacon flavour was completely dominant over the bacon notes of this and the Sosa flavour. Unfortunately, due to the lack of time in the final class, it was not possible to remake them and make them the focus of the main dish instead they were set on the side, and due to the smoky flavour were seen more like a palette cleanser or a decoration. If more hours were available, maybe the results of the sensory in that regard would be different.

Looking at my notes from the logbook that was done after each class, the origin of the problem was analysed. As mentioned in the introduction above, the meal idea had undergone a decent number of changes from the original concept, either due to the lack of time to realize the idea, the infeasibility to create the product in that short time span or the weekly change in the

available ingredients and the lack of them. The primary idea was to make a pixel art pizza slice, which was supposed to contain three different types of cubes.

Figure 7: Concept idea made after the first class

These cubes were supposed to be all same in size, but with different textures and flavours: cheese cubes were supposed to be jelly, similar to cheese (like mozzarella), bacon cubes were supposed to be crispy, while the pizza crust cubes were supposed to be crunchy. This was supposed to create intrigue and a positive response from the people trying the meal, showing the capabilities and "the magic" of note-by-note. After three classes, only the cheese cubes were perfected and could be made fast during the shortened final class (picture taking for the competition). The recipe for the bacon cubes was optimized but in the fear of not having enough time for the bacon cubes and something else, I opted to create the bacon and tomato spaghetti. The fear behind the change was that only the cheese and bacon cubes would be insufficient for a whole meal. The reasoning was that it was better to put the spaghetti in the middle, create different shapes and contrast; then use the old bacon cubes on the side (that had a flavour that was too smoky) to provide the differences in texture.

Looking at the nutritional values of the meal and its composition, there is a need to verify that the meal complies with European regulations and legislation. The current regulations do not provide a limitation in terms of an acceptable daily intake for agar (Mortensen et al., 2016) xanthan gum (Mortensen et al., 2017) or cellulose (Younes et al., 2018). As for the nutritional intake, EFSA recommends that the adequate nutritional intake of dietary fibres should be 25 g for a proper bowel movement and that the carbohydrates from starchy food should represent 45 – 60 % of the total diet (EFSA, 2010). That means that a person should consume between 100 and 278 grams daily if a person has a diet of 1600-2200 calories/day (Jacob, 2018). For the flavours, it is not possible to determine the primary chemical ingredient from the Sosa flavouring company. The packaging does not contain any reference to the content, nor does that information exist on the internet. Additionally, we were not provided with the specification/import sheets that contain the CAS numbers by the university. If we had that we could search if there were any limitations regarding the flavour in Regulation (EU) No 872/2012. Any assumptions (like for example searching what is the primary flavour in real ripe tomatoes and then searching for its approved limits), would be second guessing and not be in the spirit of note-by-note cooking. What I know as a research engineer that has worked in a flavouring company for a couple of years, is that the recommended dosage of the flavours is around 0.2%. This quantity is also recommended for flavours on Sosa's company website (Sosa, 2021). The same problem occurred whit the food colours. The chemical composition of the food colours was not stated on the packaging, or on the website of the supplier nor was the specification sheet provided, but due to my experience, I know that the recommended dosage for industrial colours (which have higher concentrations) is between 0.2% and 0.3%. Doing the precautionary principle, we will say that 0.2% is the maximal amount of food colour that could be added in order for the consumer to be safe.

Another thing to consider is that the recipe provided is for a larger quantity of food. This was done in order to be able to measure the ingredients properly. For example, the cheese recipe is around 250 cubes, a person would probably consume 15. Considering that this meal is an entry and that people will eat a small amount, we can say that this meal is safe for human consumption.

Conclusion

After four weeks of working on the dish, sensory evaluation has shown that a good and desired dish has not been created. While the general appearance, colour, and flavour resemblance of the individual pieces to the original dish received high marks, the characteristics of texture, taste and general likeness did not obtain positive marks from the respondents. As the taste of individual pieces was rated much better than the taste and subsequently general likeness, it was concluded that the texture of the whole meal was the issue. Most of the dish parts had a jelly structure, which might have underwhelmed the expectation of the person trying the dish, as the person was eating multiple pieces that have different shapes, colours, and flavours but feel in the mouth the same way. The solution would be to diversify the texture by adding food that is not jelly, like for example something crunchy or crispy.

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Logbook

MODULE CODE: TFPD9025

MODULE TITLE: Advanced molecular gastronomy

STUDENT NAME: Bogdan Dinić

FOOD PRODUCT: Pixel art pizza slice

WEEK NO.: 1 **DATE: 21.03.2022.**

Weekly Aims and Objectives

Aim: Create a note by note pizza slice in the pixel art style (made from savoury cubes), by creating three different cubes: cheese, bacon, and crust.

Objectives: Experiment with the equipment and recipes to obtain a dish. Based on the theoretical research, adapt one recipe for two different cubes: bacon and cheese, and write the results to see if the texture will be more suitable for cheese or the bacon cube.

Materials and Method (Ingredients, Equipment and Method)

Ingredients for the recipes as well as the quantities are marked in the table below:

Cheese cubes		
Trial 1 - 21.03.2022.		
Ingredient	Unit	Quantity
Cornflour (starch replacement)	g	66
Pea protein	g	28
Olive oil (oleic acid replacement)	g	14
Water	g	120
Dietary fibre cellulose (NutnCology)	g	18
Salt	g	1
Sugar (sucrose replacement)	g	2
Food colouring – yellow (Il punto Italiano)	g	0.15
Pure compound iqeuisu	g	0.15
Cheese flavour – Camembert (Sosa)	g	0.1

Table 1: Cheese cubes recipe on 21.03.2022.

Bacon cubes		
Trial 1 – 21.03.2022.		
Ingredient	Unit	Quantity
Cornflour (starch replacement)	g	66
Pea protein	g	28
Olive oil (oleic acid replacement)	g	14
Water	g	120
Dietary fibre cellulose (NutnCology)	g	18
Sugar (sucrose replacement)	g	2
Food colouring – green (Il punto Italiana)	g	0.1
Food colouring – red (Il punto Italiana)	g	0.1
Food colouring – blue (Il punto Italiana)	g	0.05
Flavour – Smokey bacon (MSK flavours)	g	0.1
Flavour – Pork back (Sosa)	g	0.05

Table 2: Bacon cubes recipe on the 21.03.2022.

Equipment used during the experiment:

- Digital pocket scale (Triton T3, 0,01 g graduation)
- Digital kitchen scale (Soehnle, 1 g graduation)

- Stainless steel bowls
- An Oven (Electrolux)
- Plastic trays
- A Whisk
- Pot

- Forks
- Knife
- Plastic moulds for cubes shape (mini-ice cubes mound 1cm x 1cm x 1cm)

Method for the cheese and bacon cubes: In a big stainless bowl mix all powdered ingredients. In the second bowl add the water-soluble food colouring and flavours and then add the oil. Mix them until the colour and oil are uniformly spread. After this, add the liquid to the powdered ingredients and whisk until the "mass" is uniform. Pour it down into the mould and put it in the oven at 160°C for 20 minutes.

Results and discussion

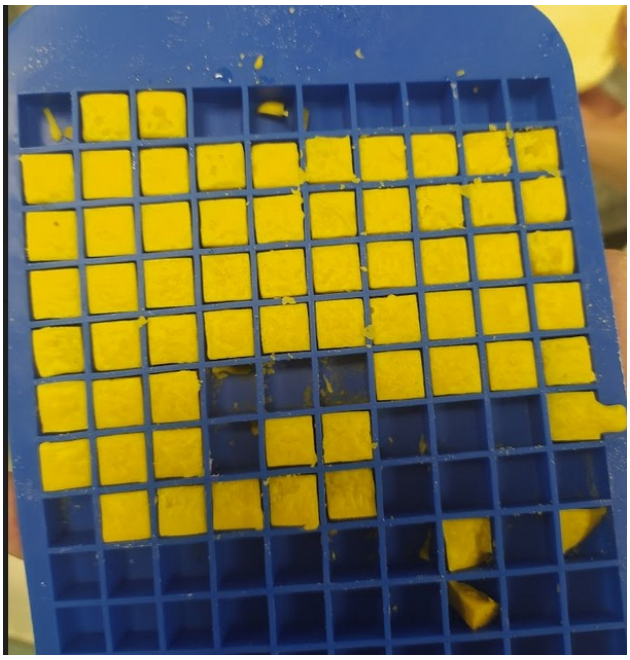


Figure 1: Cheese cubes – trial 1

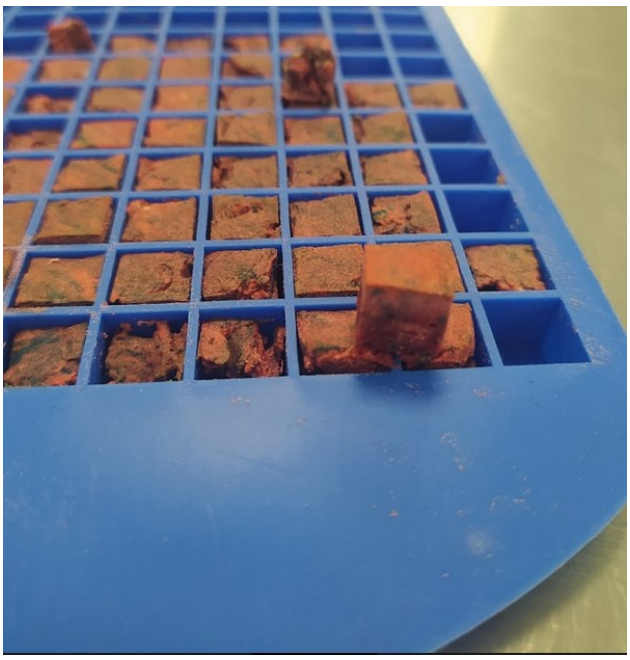


Figure 2: Bacon cubes – trial 2

Figure 3: Concept idea

Cheese cubes didn't have a cheesy taste, which was a result of a lot of pea protein in the recipe. From the theoretical research, 15 would be sufficient to bake the cubes, but even after 30 minutes, it wasn't sufficient. The top was done while the bottom was mushy. The texture wasn't resembling the texture of the cheese.

Regarding the bacon cubes, pea protein has also covered the flavour. To try to completely bake them, a temperature of 180o was set for 15 minutes The results were cubes with an overly cooked top (similar to crispy bacon) and a mushy bottom. The blue colour wasn't mixed properly so there is some colour differentiation in the cubes and between the cubes, the colour is also too light because of this.

Conclusions

With the starting recipe, it will be difficult to make acceptable textures for both cheese and bacon. The protein content is covering the flavours in both types of cubes. Proposed cooking times from the theoretical research aren't adapted for this recipe

Recommendations for the following week.

For the cheese cubes, try to prepare a new recipe for the next week, with thickeners (like agar, xanthan etc. depending on the availability. This will help with the flavour (no pea protein) and the texture (more cheese-like).

For the bacon cubes, pea protein must be excluded from the recipe so the flavour could be felt. The colour needs to be properly mixed before adding it to the powdered ingredients.

MODULE CODE: TFPD9025

MODULE TITLE: Advanced molecular gastronomy

STUDENT NAME: Bogdan Dinić

FOOD PRODUCT: Pixel art pizza slice

WEEK NO.: 2 **DATE: 01/04/2021**

Weekly Aims and Objectives

Aim: Create a note-by-note pizza slice in the pixel art style (made from savoury cubes), by creating three different cubes: cheese, bacon, and crust.

Objectives: Working on the new recipe for the cheese cubes with the agar, trying to get the texture and the taste right. For the bacon cubes, try to get the texture right by adapting the baking time. Additionally, try to improve the taste by removing pea protein from the recipe

Materials and Method (Ingredients, Equipment and Method)

Ingredients for the recipes as well as the quantities are marked in the table below:

Cheese cubes		
Trial 2 – 01/04/2022		
Ingredient	Unit	Quantity
Water	g	200
Dietary fibre cellulose (NutnCology)	g	14
Salt	g	2
Sugar (sucrose replacement)	g	3
Food colouring – yellow (Il punto Italiana)	g	0.15
Pure compound – Berthome (Iqemusu)	g	0.15
Cheese flavour – cheddar powder (Sosa)	g	6
Agar (Sosa)	g	1.75

Table 3: Cheese cubes recipe on 01.04.2022.

Bacon cubes		
Trial 2 – 01/04/2022		
Ingredient	Unit	Quantity
Cornflour (starch replacement)	g	66
Olive oil (oleic acid replacement)	g	14
Water	g	120
Dietary fibre cellulose (NutnCology)	g	14
Sugar (sucrose replacement)	g	2
Food colouring – green (Il punto Italiana)	g	0.1
Food colouring – red (Il punto Italiana)	g	0.1
Food colouring – blue (Il punto Italiana)	g	0.05
Flavour – Smokey bacon (MSK flavours)	g	0.1
Flavour – Pork back (Sosa)	g	0.05

Table 4: Bacon cubes recipe on 01.04.2022.

Equipment used during the experiment:

- Digital pocket scale (Triton T3, 0,01 g graduation)
- Digital kitchen scale (Soehnle, 1 g graduation)

- Stainless steel bowls
- An Oven (Electrolux)
- A Stove (Electrolux)
- A Freezer (Sogi)
- Plastic trays

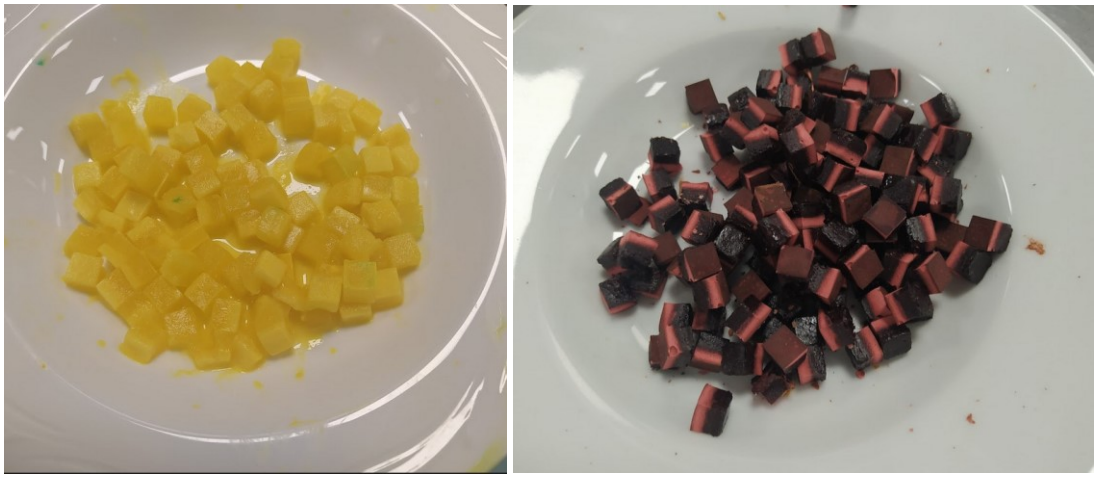
- Whisk
- Pot
- Spoons
- Forks
- Knife

- Plastic moulds for cubes shape (mini-ice cubes mound 1cm x 1cm x 1cm, Yantan)

Method for the bacon cubes: In a big stainless bowl mix all powdered ingredients. In the second bowl add the water-soluble food colouring and flavours and then add the oil. Mix them until the colour and oil are uniformly spread. After this, add the liquid to the powdered ingredients and whisk until the "mass" is uniform. Pour it down into the mould and put it in the oven at 160°C for 20 minutes.

Method for the cheese cubes: Measure all the powdered ingredients. Put the water on the stove turned on the medium-high fire. Once the water starts to boil add all the ingredients and remove it from the stove and put it in the mould. Put the mould into the freezer at -17°C for 20 minutes so the solution with the agar thickens.

Results and discussion



Figures 6 and 7: Cheese (left) and bacon (right) cubes – trial 2

Cheese cubes: after taking them out from the freezer the structure started to dissolve. The taste and colour weren't uniform in the cubes, and also there was a powdery feeling while consuming them. Generally, speaking the flavour was too intense.

Bacon cubes: Like the previous week, even though the temperature was reduced, there was again a problem with the non-equal cooking. This time the top had a crust, the middle was uncooked while the bottom got a burnt mushy texture. The cubes were inedible because of this. An observation was made that the cubes that rose out of the mould were evenly baked in the part that rose.

Conclusions

For the cheese cubes, the unevenness and the lack of structure could be explained by two things, the ingredients weren't mixed well enough, there was an insufficient amount of agar and/or it wasn't kept at high temperatures long enough. The cheese flavour was too strong. As for the bacon cubes, it is apparent that it is very difficult to bake evenly in this mould.

Recommendations for the following week.

For the cheese cubes, add the ingredients to the water as soon as the water is put on the stove and whisk constantly. Reduce the amount of cheese flavour added. For the texture, increase the amount of agar

and/or add another thickener. For the bacon cubes, try to take the cubes out of the mould once they get a stable shape.

MODULE CODE: TFPD9025

MODULE TITLE: Advanced molecular gastronomy

STUDENT NAME: Bogdan Dinić

FOOD PRODUCT: Pixel art pizza slice

WEEK NO: 3 **DATE: 04/04/2022**

Weekly Aims and Objectives

Aim: Create a note-by-note pizza slice in the pixel art style (made from savoury cubes), by creating three different cubes: cheese, bacon, and crust.

Objectives: Working on the new recipe for the cheese cubes with the agar and xanthan gum, trying to get the structure and the taste right. For the bacon cubes, try to get the texture right by taking the cubes out of the mould once the structure gets solid. Try to create pizza crust cubes with the adapted original recipe.

Materials and Method (Ingredients, Equipment and Method)

Ingredients for the recipes as well as the quantities are marked in the table below:

Cheese cubes		
Trial 3 – 04/04/2022		
Ingredient	Unit	Quantity
Water	g	200
Dietary fibre cellulose (NutnCology)	g	14
Salt	g	2
Sugar (sucrose replacement)	g	3
Food colouring – yellow (Il punto Italiana)	g	0.15
Pure compound – Berthome (Iqemusu)	g	0.15
Cheese flavour – cheddar powder (Sosa)	g	6
Agar (Sosa)	g	1.87
Xanthan gum (Sosa)	g	0.5

Table 5: Cheese cubes recipe on 04/04/2022

Bacon cubes		
Trial 3 – 04/04/2022		
Ingredient	Unit	Quantity
Cornflour (starch replacement	g	66
Olive oil (oleic acid replacement)	g	14
Water	g	120
Dietary fibre cellulose (NutnCology)	g	14
Sugar (sucrose replacement)	g	2
Food colouring – green (Il punto Italiana)	g	0.1
Food colouring – red (Il punto Italiana)	g	0.1
Food colouring – blue (Il punto Italiana)	g	0.05
Flavour – Smokey bacon (MSK flavours)	g	0.1
Flavour – Pork back (Sosa)	g	0.05

Table 6: Bacon cubes recipe on 04/04/2022

Bread crust cubes		
Trial 1 – 04/04/2022		
Ingredient	Unit	Quantity
Cornflour (Starch replacement)	g	66
Pea protein	g	14
Olive oil (oleic acid replacement)	g	14
Water	g	120
Dietary fibre cellulose (NutnCology)	g	14
Sugar (sucrose replacement)	g	2
Flavour – Bread crust (Sosa)	g	0.15

Table 7: Bread crust cubes recipe on 04/04/2022

Equipment used during the experiment:

- Digital pocket scale (Triton T3, 0,01 g graduation)
- Digital kitchen scale (Soehnle, 1 g graduation)

- Stainless steel bowls
- An Oven (Electrolux)
- A Stove (Electrolux)
- A Freezer (Sogi)
- Plastic trays

- Whisk
- Pot
- Spoons
- Forks
- Knife

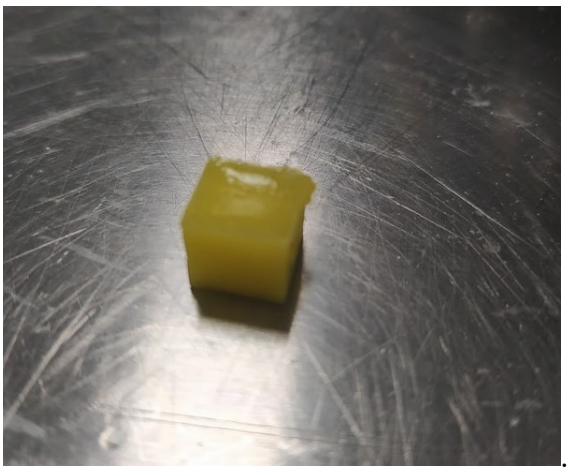
- Plastic moulds for cubes shape (mini-ice cubes mound 1cm x 1cm x 1cm, Yantan)

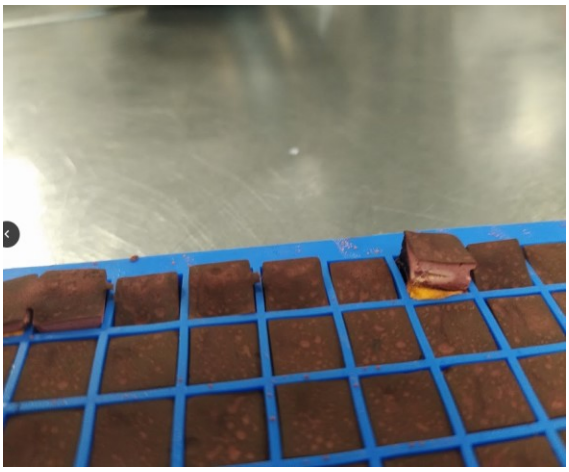
Method for the bacon cubes: In a big stainless bowl mix all powdered ingredients. In the second bowl add the water-soluble food colouring and flavours and then add the oil. Mix them until the colour and oil are uniformly spread. After this, add the liquid to the powdered ingredients and whisk until the "mass" is uniform. Pour it down into the mould and put it in the oven at 160°C for 7 minutes. Take the cubes out of the mould and onto the baking tray covered with parchment paper, putting the cubes upside down from the original position, and bake for 13 additional minutes at 160°C.

Method for the cheese cubes: Measure all the powdered ingredients. Put the water on the stove turned on the medium-high fire. Put the ingredients immediately in the water and whisk constantly. Once the water starts to boil remove it from the stove and put it in the mould. Put the mould into the freezer at -17°C for 20 minutes so the solution thickens.

Method for the bread crust cubes: In a big stainless bowl mix all powdered ingredients. In the second bowl add the water-soluble food colouring and flavours and then add the oil. Mix them until the colour and oil are uniformly spread. After this, add the liquid to the powdered ingredients and whisk until the "mass" is uniform. Pour it down into the mould and put it in the oven at 160°C for 20 minutes.

Results and discussion





Figures 8 and 9: Cheese cube (left) and bacon (smoky) cubes (right) on trial 3

Cheese cubes have reached the desired texture and taste, having a clear yellow colour and an intensive cheddar flavour. The texture is solid and "rubbery" slightly reminding of the ones of mozzarella. As they heat up toward the room temperature, the quality of the taste reduces, and it starts to be a bit floury. Bacon cubes finally achieved a uniform crunchy structure. The flavour is predominantly smoky, instead of tasting the bacon more. The pizza crust cubes did not turn out good. The colour was too pale, not achieving the crusty structure of bacon cubes. The crust flavour is too weak, particularly non-detectable in these quantities.

Conclusions

For the cheese cubes, the recipe was formulated, and any additional changes are unnecessary. Bacon cubes reached the desired texture and colour but the only available bacon flavour has an aroma that is too smoky. With only one class remaining, it will be difficult to create pizza crust cubes, due to the fact that a lot of parameters must be corrected. The current pizza cube idea will be difficult to implement in only one more class.

Recommendations for the following week

As the recipe will be difficult to completely formulate in one more class, there is a need to search for alternatives. As we have cheese cubes that are ready, and bacon cubes that are smoky cubes than bacon cubes, an alternative to these cubes must be found. Creating some central piece that would be complemented with cheese cubes and the whole or grated "smoky" cubes might be the idea that would generate the best meal by the end of the next class.

MODULE CODE: TFPD9025

MODULE TITLE: Advanced molecular gastronomy

STUDENT NAME: Bogdan Dinić

FOOD PRODUCT: Pixel art pizza slice

WEEK NO: 4 **DATE: 04/04/2022**

Weekly Aims and Objectives

Aim: ~~Create a note-by-note pizza slice in the pixel art style (made from savoury cubes),~~ Create a note-by-note reimagined pizza, that will have tomato and bacon spaghetti accompanied with cheese and smoky cubes (failed bacon cubes) on the side.

Objectives: Create a tomato and bacon spaghetti recipe and repeat the recipe from the previous class on cheese cubes. Put the prepared food on the dish for the pictures to be taken for the competition.

Materials and Method (Ingredients, Equipment and Method)

Ingredients for the recipes as well as the quantities are marked in the table below:

Cheese cubes		
Trial 4 – 04/04/2022		
Ingredient	Unit	Quantity
Water	g	200
Dietary fibre cellulose (NutnCology)	g	14
Salt	g	2
Sugar (sucrose replacement)	g	3
Food colouring – yellow (Il punto Italiana)	g	0.15
Pure compound – Berthome (Iqemusu)	g	0.15
Cheese flavour – cheddar powder (Sosa)	g	6
Agar (Sosa)	g	1.87
Xanthan gum (Sosa)	g	0.5

Table 8: Cheese cubes recipe on 04/04/2022

Tomato spaghetti		
Trial 1 – 04/04/2022		
Ingredient	Unit	Quantity
Water	g	150
Dietary fibre cellulose (NutnCology)	g	8
Agar (Sosa)	g	1.5
Sugar (Sucrose replacement)	g	2
Salt	g	1
Tomato powder flavouring (Sosa)	g	4.5
Ripe tomato flavour (Sosa)	g	0.1
Vegetable flavour (Sosa)	g	0.05
Lactic acid (Essedielle)	g	1
Food colouring – red (Il punto Italiana)	g	0.1

Table 9: Tomato spaghetti recipe on 04/04/2022

Bacon spaghetti		
Trial 1 – 04/04/2022		
Ingredient	Unit	Quantity
Water	g	150
Dietary fibre cellulose (NutnCology)	g	8
Sugar (Sucrose replacement)	g	3
Salt	g	2
Agar	g	1.5
Food colouring – green (Il punto Italiana)	g	0.1
Food colouring – red (Il punto Italiana)	g	0.1
Food colouring – blue (Il punto Italiana)	g	0.05
Flavour – Smokey bacon (MSK flavours)	g	0.05
Flavour – Frankfurt sausage (Sosa)	g	0.05
Flavour – Pork back (Sosa)	g	0.05

Table 9: Bacon spaghetti recipe on 04/04/2022

Equipment used during the experiment:

- Digital pocket scale (Triton T3, 0,01 g graduation)
- Digital kitchen scale (Soehnle, 1 g graduation)

- Stainless steel bowls
- A Stove (Electrolux)
- A Freezer (Sogi)
- Plastic trays

- Whisk
- Pot
- Spoons
- Forks
- Knife

- Plastic moulds for cubes shape (mini-ice cubes mound 1cm x 1cm x 1cm)
- A syringe of 50 ml (Special Ingredients)
- Silicone tubing 0.5cm inner diameter (Special Ingredients)

Method for the cheese cubes: Measure all the powdered ingredients. Put the water on the stove turned on the medium-high fire. Put the ingredients immediately in the water and whisk constantly. Once the water starts to boil remove it from the stove and put it in the mould. Put the mould into the freezer at -17°C for 20 minutes so the solution thickens. Take the cubes out of the mould.

Method for the tomato spaghetti: Measure all the ingredients into separate bowls. Add the lactic acid to the water and whisk until it is spread evenly. Add and colour and whisk until the colour is uniform, after which add the powdered ingredients. Put the mixture in the pot and set it on the stove on a medium-high fire. Whisk until the mixture boils, after which remove it from the stove while whisking for 2 more minutes. Fill one big bowl with cold water which will be used for cooling the solution. Fill the syringe with the mixture and attach the silicone tubing to the syringe. Blow out the content of the syringe through the tubing until the whole tubing is filled with the mixture, after which detach the syringe. Except for the last five centimetres from both sides, tubing is to be submerged below the water. Leave the tubing with the mixture to cool down for one minute, after which use a clean syringe to blow out the "spaghetti" from the tubing.

Method for the bacon spaghetti: Measure all the ingredients into separate bowls. Add colours into the water and whisk until the colour is uniform, after which add the powdered ingredients. Put the mixture in the pot and set it on the stove on a medium-high fire. Whisk until the mixture boils, after which remove it from the stove while whisking for 2 more minutes. Fill one big bowl with cold water which will be used for cooling the solution. Fill the syringe with the mixture and attach the silicone tubing to the syringe. Blow out the content of the syringe through the tubing until the whole tubing is filled with the mixture, after which detach the syringe. Except for the last five centimetres from both sides, tubing is to be submerged below the water. Leave the tubing with the mixture to cool down for one minute, after which use a clean syringe to blow out the "spaghetti" from the tubing.

Results and discussion

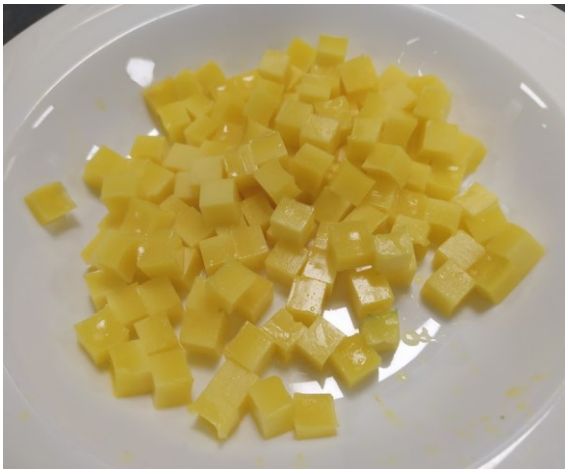


Figure 10: Cheese cubes – trial 4

Figure 11: Tomato and bacon spaghetti – trial 1

*Figure 12: Complete **pizza – redefined** dish*

As the previous week, cheese cubes have reached the desired texture and taste, having a clear yellow colour and an intensive cheddar flavour, with the texture reminding of the ones of mozzarella. The tomato spaghetti reached the desired structure but with slightly higher acidity in the taste. As for the bacon spaghetti, the texture was satisfactory as with the tomato spaghetti. The colour was a bit darker than expected, being more on the darker side of brown than having a standard bacon colour. The blend of flavours is good and similar to real bacon.
The results and the discussion about the sensory evaluation have been moved to the main part of the report, to avoid text repetition.

Conclusions

Cheese cubes have shown good characteristics as the previous week. For the tomato and bacon spaghetti, even though there is some lack in the flavour in the colouring they aren't fatal and won't destroy the impression of the final meal. As this is the last class in the kitchen, there isn't time to further improve the taste, so they must be implemented into the final meal. The whole meal combination has shown satisfactory results, even though more classes are needed to completely finalize the dish.