

Molecular Gastronomy

TFCS 4025

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Note by Note Cooking



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Background

Note-by-Note cooking was created in 1994 and the principles of it were described in *Scientific American* journal. It was invented by Herve This with the help of Nicholas Kurti. Note-by-Note cooking is an application of molecular gastronomy that involves the use of pure compounds replacing meat, fish, vegetables and fruits to create completely new dishes.

For example, acetic acid is the compound that is mostly known to affect the acidity of vinegar and vanillin, and is also the main compound of vanilla smell. (This, 2014)

This method has already been shown by a few chefs, including the French chef Pierre Gagnaire, who owns restaurants in different cities of the world. The first Note-by-Note meal was served by chefs of Cordon Bleu School in Paris in 2010 to the participants of the 2010 courses at the Institute for Advanced Studies in Gastronomy. (This, 2013)

In 2019/2020 International Contest of Note-by-Note cooking runs the 8th annual competition and the aim is to create a dish using pectins with the lowest amount of sugar used for gelling.

According to Seymour *et al.* (2002), pectins are found in cell walls of dynamic multicellular plant organs and are known to be complex, branched and acidic heteropolysaccharides.

Pectins contribute to the adhesion between cells and to the mechanical strength of the cell wall, behaving in a stabilized gel manner. Pectin polysaccharides consist of D-galacturonic acid, joined in chains by glycosidic linkages. (Walter, 2012)

Vaclavik *et al.* (2007) state that pectins consist of high molecular-weight pectinic acids and are dispersible in water. A few carboxyl groups along the galacturonic acid chain can be esterified with methanol. The extent of esterification of unmodified pectins varies from 60% in apple pulp to 10% in strawberries. Depending on esterification degree, pectins are classified as high-methoxyl or low-methoxyl. The classifications differ in properties and gel under different conditions.

Low-methoxyl pectins have more free carboxyl groups and only 20-40% of those are esterified, therefore the majority of them are available to form cross-links with divalent ions, such as calcium. A three-dimensional network that traps liquid and forms gel is formed, if enough cross-links are formed. Low-methoxyl pectins can

therefore form gels in the presence of divalent ions without the addition of sugar or acid.

High-methoxyl pectins contain around 50-58% of esterified carboxyl groups and therefore the majority of acid groups are not able to form cross-links with divalent ions and do require the addition of sugar and acid to form gels. High-methoxyl pectins are usually used for pectin jellies.




When making gels using high-methoxyl pectins, it is important to add enough sugar to the fruit mixture and allow it to penetrate into the fruit to reach osmotic equilibrium. It is also important to add citric acid or other acids to reduce pH to 3.0-3.1 in order for pectins to work.



When making gels with low-methoxyl pectins, sugar and acidity are not as important, as the addition of calcium, which can be introduced in a form of dairy products.

High-methoxyl pectin gels cannot be melted again, if set, whereas melting temperature of low-methoxylyl gels is insignificant and they can be melted again after setting. Low-methoxyl gels solidify a lot faster than high-methoxyl gels, which build up over time. (Dumitriu, 1998)

Final Materials and Methods

Materials

Whisk		Stainless Steel Balloon Whisk 35.6cm/ 14inch
Wooden Spoon		Vogue Wooden Spoon 10inch
Saucepan		Paderno Professional 1.5 Qt. Sauce Pan, Small
Oven		Convotherm DB:K21 PIA MCB: 46B

<p>Scales</p>		<p>SilverCrest Digital Spoon Scale</p>
<p>Silicone Mould</p>		<p>Flexible silicone mold - 15 petits-fours, Flexipad - Paderno</p>
<p>Baking Tray</p>		<p>Convothem 3001091 Roasting & Baking Tray</p>
<p>Mixing Bowls</p>		<p>3.5 QT, 5 QT</p>
<p>Measuring Jug</p>		<p>Gobel Stainless Steel Measuring Jug 1 Ltr</p>

<p>Blow Torch</p>		<p>Blazer - Big Shot GT 8000 Butane Torch - Black</p>
<p>Hand Blender</p>		<p>Braun Multiquick 450W Hand Blender - Soup White, MQ100</p>
<p>Gas Cooktop</p>		<p>Ambassade De Bourgogne Gas Cooktop, CSG 730 CF</p>
<p>Piping bags</p>		<p>Lekue Disposable Piping Bags</p>

Methods

Lemon Jelly:

- 4.2 g Sosa Fruit Pectin NH
- 2 g Louis Francois Citric Acid Monohydrated E330
- 20 g Puresweet Powdered Erythritol
- 0.2 g Texturas Gluco Powdered Mix of Two Calcium Salts
- 5 drops Iqemusu Baliqin
- 5 drops Iqemusu Cocci
- 20 g Millac VALUE Skimmed Milk Powder with Non-Milk Fat
- 3 drops Millard Ferriere Jaune Citron Liquid Colouring
- 200 ml Water

In a saucepan combine fruit pectin, citric acid, erythritol, calcium and water, and blitz it with a hand blender until all the powders are dispersed in water and there are no lumps, for approximately 30 seconds. Put the saucepan on the gas cooktop and bring the mixture to 80°C, stirring occasionally. Take the mixture off the heat and let it cool down until warm to touch. Add 5 drops of Baliqin and 5 drops of Cocci, as well as 3 drops of liquid colouring and mix with a whisk. Pour the mixture into the silicone moulds and let it set until it is firm and easy to take out of the moulds.

Crumb:

- 30 g Le Gourmet Wholefoods Potato Flour
- 15 g Water
- 6 g Weizengluten Powdered Gluten
- 20 g Puresweet Powdered Erythritol
- 25 g KTC 100% Pure Coconut Oil

Put coconut oil into a saucepan, melt and let it cool down. Combine all of the ingredients together in a medium mixing bowl and mix by hand until the crumbly dough is formed. The dough should look like crumbs but should stick together. Transfer the dough onto the baking tray that can be brushed with oil in advance. Form 5 mm thick shapes, they should not be symmetrical, and bake in the preheated oven

for 12 minutes at 180⁰C. After 12 minutes, take the tray out and let the crust cool down. When the crust is cool, break it with hands until it resembles the crumb.

Meringue:

- 20 g Louis Francois Blanc Gallia Powdered Egg Whites
- 60 g Water
- 15 g Puresweet Powdered Erythritol

Combine egg whites and water in a large mixing bowl and start whisking using a whisk. When the mixture starts to come together, start adding erythritol slowly, while whisking. When the mixture comes to soft peaks, transfer to the piping bag and cut a small tip for the mixture to come out. When the meringue is piped on top of the dessert, use a blow torch to give the meringue a caramel colour.

Aim

To create a dish using Note-by-Note cooking application that involves gelling of pectin, while using the minimum amount of sugar.

Final Results

The dish that was created was a recreation of a lemon meringue pie using pure compounds and Note-by-Note cooking application.

The lemon jelly was made using Sosa Fruit Pectin NH, as it was found to be the best working in a low sugar environment. It set quickly and was firm but still melted in the mouth. To add taste and smell to the jelly without adding different ingredients, two pure compounds were added. The first pure compound used was Iqemus Baliqin, which represented the sweetness of the jelly. The second pure compound was Iqemus Cocci, which gave out lemon notes.

The sugar content was substituted with erythritol, as it had the closest taste to sugar, however was less sweet. Most of the sweeteners tend to be very sweet and have a very specific taste, whereas erythritol did not have those attributes.

Because the pectin used was low-methoxyl pectin, it did not require sugar or acidity in order to gel, however calcium was needed, therefore 0.2 grams of calcium were added, in order for the jelly to set.

The rest of the ingredients were added for taste and colour.



Figure 1: Lemon jelly cooling down, before the addition of liquid colouring and pure compounds.



Figure 2: Lemon jelly poured into the mould to let it set, after adding pure compounds and colouring.

Figure 3: Lemon jelly taken out of the mould and ready to be plated.



For the crumb, potato flour was used as it worked out the best, and the crust was easy to crumb and reminded of the texture of a soft biscuit. Erythritol was also used to replace sugar and it worked well in this recipe.

The amount of water and gluten were the hardest to figure out, as only the smallest amount of both was required. When too much water and gluten were added at first, the final product resembled pita bread more than a crust. Overall, it has been the hardest recipe to work on, but at the end it turned out very well.

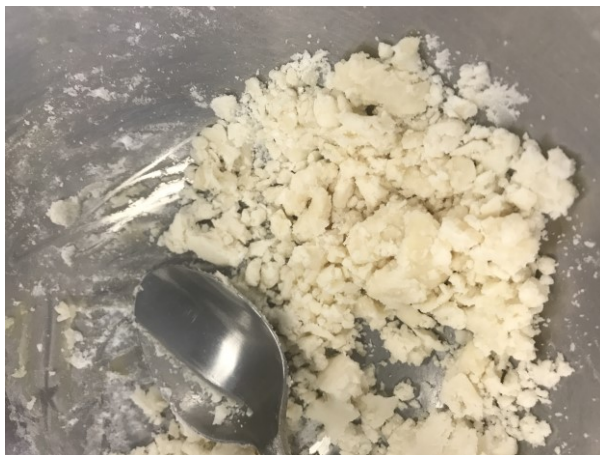


Figure 4: The dough, when all of the ingredients were mixed together, it resembled the crumb, but if it was put together, the dough was still holding shape.

Figure 5: The crust came out of the oven.



Figure 6: The final crumb that was ready to be plated.

As for the meringue recipe, the proportions that had to be followed were 3:1 water to egg white powder. The mixture was mixed together and then whisked with the slow addition of erythritol for sweetness. The meringue was done when soft peaks were formed and was piped directly on the dessert. The bow torch was used to caramelize the top of the meringue, the same way it can be seen on a real lemon meringue pie. Making meringue out of powdered egg whites was as easy as out of real egg whites.



Figure 7: Meringue ready to be transferred in a piping bag.

Figure 8: Meringue piped on an empty surface.





Figure 9: The final picture of the dessert.

Sensory Analysis

The sensory test that was chosen to analyze the dish was hedonic scaling. According to Lawless *et al.* (1999), this test is also known to be a degree-of-liking scale and was invented in 1940s to determine the degree of liking for food samples. The hedonic scale test works on a base that consumer preferences exist on a continuum and it can be expressed as like or dislike responses.

It has also been found that when carrying out the hedonic scale test, the positioning on the score sheet, whether it was printed vertically or horizontally, did not affect the results.

The words chosen for each scale option are important in the assignment of numerical values to the response choices and to the use of parametric statistics when analysing the results. The scale options should be based on equal interval spacing and have rulerlike properties.

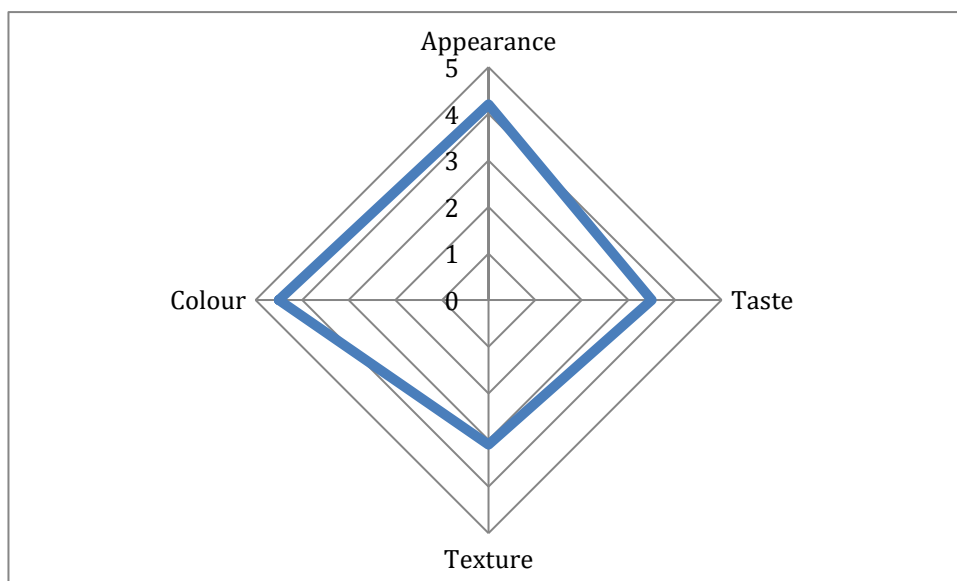
The 5-scale hedonic test was chosen with 1 = extremely dislike and 5 = extremely like. People were asked to taste the final sample and to evaluate the taste, appearance, texture and colour.

Results:

Table 1: The final results of the analysis and the mean

Judge	Appearance	Taste	Texture	Colour
1	3	3	2	4
2	4	4	3	5
3	4	4	3	5
4	4	4	4	4
5	5	3	4	4
6	4	3	2	5
7	5	4	3	4
8	5	3	3	4
9	4	4	4	5
10	4	3	3	5
Mean	4.2	3.5	3.1	4.5

Figure 10: Spider Plot of the results



- 1 = extremely dislike
- 2 = dislike
- 3 = nor like, not dislike
- 4 = like
- 5 = extremely like

Figure 10 shows the spider plot of the results of the sensory analysis. The shape formed by the data is almost square shape, however with an extreme point towards colour, where the mean worked out to be 4.5. Texture was the least likely attribute with a mean of 3.1. As none of the point are in the centre, the dish was not found to be unappealing, however texture and taste can be worked on.

Discussion

The aim of this module was to create a dish using pectin, that would gel with a minimum amount of sugar used. This aim was achieved using molecular gastronomy methods and techniques.

The idea of making a lemon meringue pie came to mind, as the lemon filling has a jelly-like consistency and it was interesting to see how the whole dish would turn out using pure compounds.

The main struggle was to determine not only the ingredients, but also the amount, and therefore every week was all about the corrections and figuring out what worked better or worse.

The final dish was a big improvement from how it started out, but still had some parts to work on.

An informal sensory analysis was performed with other people in class and the results showed that overall the dish was appealing but flavour and texture could have been adjusted.

The main aim was achieved, the jelly did thicken in a low sugar environment, but it was not only about the texture, the taste was even more important. If the dish does not taste good, people would not even try it.

Pure compounds were used to give flavour to the dish. As described by Vega *et al.* (2013) pure compounds are used in note by note cuisine to build all aspects of the

dish, such as taste, odour, colour, texture, and so on. They also compare pure compounds to music, where pure compounds are pure frequencies in music and plant or animal-based materials resemble instruments.

The 24 pure compound notes were used and were supplied by Iqemusu (2019), where the notes are described as pure compounds that contribute in nature to the taste of different food products. The notes can be used on their own or can be combined to give unique flavours and create new tastes. Three different evocations come with each bottle of pure compounds. The first and main evocation is the strongest, the second and third are generally more subtle. The product is a mix of several ingredients and each note can be present in numerous food products but has different strengths.

The two compounds used for the recipe were Baliqin and Cocci. Baliqin has banana, candy and sweetness evocation and as stated on Iqemusu, it can be found in fruit including apples, bananas, pears, apricots and nectarines. Cocci has tropical lemon, woody and cola evocation and in the wild, the note can be found in papaya and citrus fruit.

Combination of those two notes made a perfect taste for the lemon jelly, providing both citrus and candy evocations. Pure compounds were interesting to work with and should be used more by chefs, however any additives tend to get bad reputation due to people not having enough knowledge on them.

Herve This describes clean label movement in the article written by Michail (2018). He says that people do not understand that food is naturally made up of chemical compounds. Some food manufacturers remove additives that sound like chemicals and therefore make the public be afraid of those ingredients.

However, citric acid and caramel are both food additives, which do not scare people as much.

Overall, if people get more educated on what food is made out of and why chemical compounds are not bad, note by note cooking will have a great chance to become popular amongst not only chefs, but even those cooking at home, as it is so easy to just add a few drops to lift up the dish to a new level.

Conclusion

Overall, Note-by-Note cooking allows to elevate known dishes using unique ingredients and flavours. The aim of the module was achieved and the final result did not only lift up a common dish to a new level, but also reached unique flavours and textures.

It is certain, that Note-by-Note cooking can be used by both chefs and amateurs, who want to achieve great results with new flavours.

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Logbook

Week 1

Aim: To find which type of pectin and in what concentration works the best in a low sugar environment.

Equipment:

- 3 saucepans
- Wooden spoon
- Whisk
- Scales
- Silicone mould
- Mixing bowls
- Measuring jug
- Hand blender
- Gas cooktop

Methods:

Four different pectins were used: fruit pectin, x58 pectin, yellow pectin, and low sugar pectin. Sorbitol was used to replace the sugar.

Jelly using 1.5% low sugar pectin:

- 200 ml water
- 3 g low sugar pectin
- 5.5 g sorbitol
- 0.2 g calcium lactate

Mix pectin, sorbitol and calcium lactate in a saucepan and add 200 ml of water. Blend the mixture with a hand blender for 30 seconds or until the dry ingredients are

dispersed in water. Put the saucepan on a medium heat and bring to 80⁰C. Let the mixture cool and observe if it thickens.

Jelly using 2% low sugar pectin:

- 200 ml water
- 4.1 g low sugar pectin
- 5.5 g sorbitol
- 0.2 g calcium lactate

Mix pectin, sorbitol and calcium lactate in a saucepan and add 200 ml of water. Blend the mixture with a hand blender for 30 seconds or until the dry ingredients are dispersed in water. Put the saucepan on medium heat and bring to 80⁰C. Let the mixture cool and observe if it thickens.

Jelly using 1.5% fruit pectin:

- 200 ml water
- 3 g fruit pectin
- 5.5 g sorbitol
- 0.2 g calcium lactate

Mix pectin, sorbitol and calcium lactate in a saucepan and add 200 ml of water. Blend the mixture with a hand blender for 30 seconds or until the dry ingredients are dispersed in water. Put the saucepan on medium heat and bring to 80⁰C. Let the mixture cool and observe if it thickens.

Jelly using 2% fruit pectin:

- 200 ml water
- 4.1 g fruit pectin
- 5.5 g sorbitol
- 0.2 g calcium lactate

Mix pectin, sorbitol and calcium lactate in a saucepan and add 200 ml of water. Blend the mixture with a hand blender for 30 seconds or until the dry ingredients are

dispersed in water. Put the saucepan on medium heat and bring to 80°C. Let the mixture cool and observe if it thickens.

Jelly using 1% X58 pectin:

- 200 ml water
- 2 g X58 pectin
- 5.5 g sorbitol
- 0.2 g calcium lactate

Mix pectin, sorbitol and calcium lactate in a saucepan and add 200 ml of water. Blend the mixture with a hand blender for 30 seconds or until the dry ingredients are dispersed in water. Put the saucepan on medium heat and bring to 80°C. Let the mixture cool and observe if it thickens.

Jelly using 2% yellow pectin:

- 200 ml water
- 4.1 g yellow pectin
- 5.5 g sorbitol
- 0.2 g calcium lactate

Mix pectin, sorbitol and calcium lactate in a saucepan and add 200 ml of water. Blend the mixture with a hand blender for 30 seconds or until the dry ingredients are dispersed in water. Put the saucepan on medium heat and bring to 80°C. Let the mixture cool and observe if it thickens.

Results

Pectin	Consistency	Worked/Not Worked
1.5% low sugar pectin	Liquid	Not worked
2% low sugar pectin	Liquid	Not worked
1.5% fruit pectin	Thicker jam consistency	Worked
2% fruit pectin	Jam consistency	Worked
1% X58 pectin	Stable thick jelly	Worked
2% yellow pectin	Thicker liquid	Not worked

Reccomendations:

To use erythritol instead of sorbitol as it is more similar to sugar and is less sweet.

Week 2:

Objectives:

- To work on crumb recipes
- To establish the best recipe for jelly
- To test out meringue recipe using egg white powder

Equipment:

- 3 saucepans
- Wooden spoon
- Whisk
- Scales
- Silicone mould
- Mixing bowls
- Measuring jug
- Hand blender
- Gas cooktop
- Oven
- Baking tray
- Piping bag

Methods:

Crumb recipe 1:

- 15 g constarch
- 50 g water
- 15 g powdered gluten
- 20 g erythritol

Combine all of the ingredients together in a medium mixing bowl and mix by hand until the dough is formed. Transfer the dough onto the baking tray that can be brushed with oil in advance. Form 5 mm thick shapes, they should not be symmetrical, and bake in the preheated oven for 12 minutes at 180⁰C. After 12 minutes, take the tray out and let the crust cool down. Check if the crust worked.

Crumb recipe 2:

- 30 g constarch
- 15 g water
- 6 g powdered gluten
- 20 g erythritol
- 25 g pure coconut oil

Put coconut oil in a saucepan and let it melt, then cool down. Combine all of the ingredients together in a medium mixing bowl and mix by hand until the dough is formed. Transfer the dough onto the baking tray that can be brushed with oil in advance. Form 5 mm thick shapes, they should not be symmetrical, and bake in the preheated oven for 12 minutes at 180⁰C. After 12 minutes, take the tray out and let the crust cool down. Check if the crust worked.

Crumb recipe 3:

- 30 g constarch
- 30 g water
- 6 g powdered gluten
- 20 g erythritol

Combine all of the ingredients together in a medium mixing bowl and mix by hand until the dough is formed. Transfer the dough onto the baking tray that can be brushed with oil in advance. Form 5 mm thick shapes, they should not be symmetrical, and bake in the preheated oven for 12 minutes at 180⁰C. After 12 minutes, take the tray out and let the crust cool down. Check if the crust worked.

Meringue recipe:

- 20 g powdered egg whites
- 60 g water
- 15 g erythritol

Combine egg whites and water in a large mixing bowl and start whisking using a whisk. When the mixture starts to come together, start adding erythritol slowly, while whisking. When the mixture comes to soft peaks, transfer to the piping bag and cut a small tip for the mixture to come out. When the meringue is piped on top of the dessert, use a blow torch to give the meringue a caramel colour.

Jelly recipe 1:

- 4.2 g fruit pectin
- 3 g citric acid
- 15 g erythritol
- 0.2 g calcium lactate
- 5 drops Iqemus Cocci
- 20 g skimmed milk powder
- 3 drops yellow food colouring
- 200 ml water

In a saucepan combine all of the dry ingredients together with water and blitz it with a hand blender until all the powders are dispersed in water and there are no lumps, for approximately 30 seconds. Put the saucepan on the gas cooktop and bring the mixture to 80°C, stirring occasionally. Take the mixture off the heat and let it cool down until warm to touch. Add 5 drops of Cocci, as well as 3 drops of liquid colouring and mix with a whisk. Pour the mixture into the silicone moulds and let it set until it is firm and easy to take out of the moulds.

Jelly recipe 2:

- 4.2 g fruit pectin
- 3 g citric acid
- 20 g erythritol
- 0.2 g calcium lactate
- 5 drops Iqemus Cocci
- 20 g skimmed milk powder
- 3 drops yellow food colouring
- 200 ml water

In a saucepan combine all of the dry ingredients together with water and blitz it with a hand blender until all the powders are dispersed in water and there are no lumps, for approximately 30 seconds. Put the saucepan on the gas cooktop and bring the mixture to 80°C, stirring occasionally. Take the mixture off the heat and let it cool down until warm to touch. Add 5 drops of Cocci, as well as 3 drops of liquid colouring and mix with a whisk. Pour the mixture into the silicone moulds and let it set until it is firm and easy to take out of the moulds.

Jelly recipe 3:

- 4.2 g fruit pectin
- 2 g citric acid
- 20 g erythritol
- 0.2 g calcium lactate

- 5 drops Iqemusu Baliqin
- 5 drops Iqemusu Cocci
- 20 g skimmed milk powder
- 3 drops yellow food colouring
- 200 ml water

In a saucepan combine all of the dry ingredients together with water and blitz it with a hand blender until all the powders are dispersed in water and there are no lumps, for approximately 30 seconds. Put the saucepan on the gas cooktop and bring the mixture to 80°C, stirring occasionally. Take the mixture off the heat and let it cool down until warm to touch. Add 5 drops of Cocci and 5 drops of Baliqin, as well as 3 drops of liquid colouring and mix with a whisk. Pour the mixture into the silicone moulds and let it set until it is firm and easy to take out of the moulds.

Results:

When testing out crumb recipes, the results were not as satisfactory. The first recipe turned out to resemble pita bread and was not crumbling. It turned out that too much gluten and water were added. As for the second and third recipes, the crumb turned out too hard and was hard to eat.

The meringue recipe worked out great and would be used for a final recipe.

As for the jelly, the best recipe turned out to be the third one and would be used for a final dish. The first two recipes were either too sour, or not sweet enough. The final 5 drops of Iqemusu Baliqin pure compound, helped to change the flavour and make the taste a little more sweet.

Reccomendations:

To further test out the crumb recipe, trying to use potato flour instead of cornstarch.

Week 3:

Aim: To work out the final crumb recipe and to put the final dish together in order to run a sensory test.

Equipment:

- 3 saucepans
- Wooden spoon
- Whisk
- Scales
- Silicone mould
- Mixing bowls
- Measuring jug
- Hand blender
- Gas cooktop
- Oven
- Baking tray
- Piping bag

Methods:

Crumb recipe 1:

- 30 g potato flour
- 6 g powdered gluten
- 20 g erythritol
- 25 g coconut oil

Put coconut oil in a saucepan and let it melt, then cool down. Combine all of the ingredients together in a medium mixing bowl and mix by hand until the dough is formed. Transfer the dough onto the baking tray that can be brushed with oil in advance. Form 5 mm thick shapes, they should not be symmetrical, and bake in the preheated oven for 12 minutes at 180°C. After 12 minutes, take the tray out and let the crust cool down. Check if the crust worked. Crumb it using hands.

Crumb recipe 2:

- 30 g potato flour
- 15 g water
- 6 g powdered gluten
- 20 g erythritol
- 25 g coconut oil

Put coconut oil in a saucepan and let it melt, then cool down. Combine all of the ingredients together in a medium mixing bowl and mix by hand until the dough is formed. Transfer the dough onto the baking tray that can be brushed with oil in advance. Form 5 mm thick shapes, they should not be symmetrical, and bake in the preheated oven for 12 minutes at 180°C. After 12 minutes, take the tray out and let the crust cool down. Check if the crust worked. Crumb it using hands.

Results:

Using potato flour worked out a lot better in a crumb recipe. The first recipe turned out to be a little too dry and therefore water was used for the second recipe. The second recipe was crumbling easily and reminded of the consistency of a really soft biscuit. The crumb recipe was used for a final dish and the sensory analysis was established.

Sensory Analysis Template

Please taste the sample presented in front of you and on the scale from 1 to 5, indicate how much you like or dislike the product.

1 = dislike extremely

2 = dislike

3 = nor like, nor dislike

4 = like

5 = extremely like

Judge	Colour	Appearance	Taste	Texture
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				