

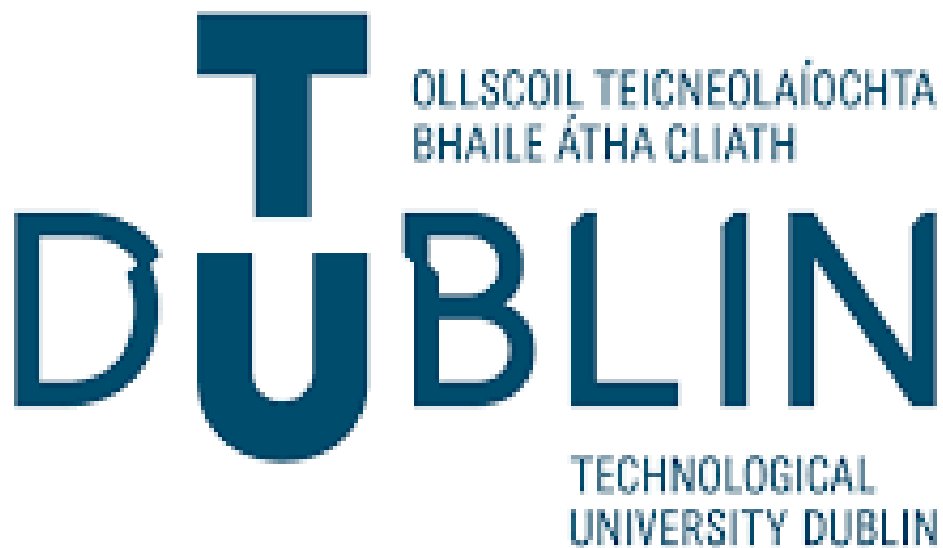
Molecular Gastronomy

Lecturer: Roisin Burke

Student Name: Elizabeth O'Dwyer

Student Number: C16463704

Course Code/Year: DT405/4



Background:

Molecular Gastronomy is the application of scientific principles to the understanding and improvement of small-scale food preparation. The term was invented by the Hungarian physicist Nicholas Kurti in a 1969 presentation to the Royal Institution called "The Physicist in the kitchen", and popularized by his collaborator the French scientist Hervé This (Scienceofcooking.com, 2020). Molecular gastronomy is based on science however it is still a mix of science and art of cooking. The scientific component is understood through various techniques, tools and ingredients used for cooking. Some of these techniques include : Spherification (used for producing a caviar-like spheres), the use of emulsifiers, Aromatic component (gases trapped in a bag, a serving device, or the food itself), Unusual flavour combinations, such as combining savoury and sweet and flavour juxtaposition, Creating new food textures (gels, foams, glass like food) and improved temperature control. Following this some molecular gastronomy tools and ingredients include : Liquid nitrogen, Food dehydrator, Centrifuge, Vacuum machine, Pressure cookers, Gelling agents (e.g. methylcellulose), Sugar substitutes, Emulsifiers (e.g. soy lecithin and xanthan gum), Carbon dioxide, for adding bubbles and making foams and Hydrocolloids such as starch, gelatin, pectin and natural gums (Kovac, 2020).

Note-by-note style of cooking replaces traditional ingredients such as meat and vegetables with their chemical constituents. Herve This was a discoverer of this and his technique seeks to deconstruct ingredients such as meat and vegetables into individual chemical constituents like lipids and amino acids. After identification of the fundamental chemical make-up of dishes, this then mixes those raw compounds to reconstruct the essence of traditional dishes. Using chemical compounds will not only prevent food spoilage that occurs during the transportation of crops and animal products, it can feed more people. At the moment there are 24 pure compounds/notes available which are named: Amerise, Baliqin, Berthome, Carez, Chapre, Chole , Cocci, Coch, Conq, Copesca, Ermel, Flose, Frum, Hertzson, Mapo, Monka, Naha, Onium, Perqoi, Piovo, Poppe, Sfummo, Silv, Thian (Iqemusu, 2020).

For this project Pectin is a key component and plays a vital role in molecular gastronomy.

Pectin is a type of starch, called a heteropolysaccharide. Pectin is a group of substances which forms gels when dissolved in water under suitable conditions. It is derived from the protopectin found in the middle lamellae of plant cells. Protopectin is insoluble, but is

converted to soluble pectin as fruit ripens or is heated in an acid medium. Pectin is a negatively charged colloid in an acid fruit substrate. As sugar is added to this colloid, the pectin–water equilibrium breaks down, and a fibrous network capable of supporting liquids is established. The fibre network forms the gel necessary for jams, jellies, and preserve. The main use for pectin is gelling, thickening and stabilizing. It is mostly known for its use in jams, jellies and marmalades for gelling in presence of sugar and citric acid. Commercial pectin's are usually made from citrus rinds. It is sold as a dry powder and in liquid form. There are two main types of pectin: high methoxyl (HM) and low methoxyl (LM). High methoxyl pectin is the most common type and is often labelled as fast or rapid-set or slow-set, in nature, pectin is HM. During production, its degree of methyl esterification can be modified, producing LM pectin's that are more suitable for different applications.

Low methoxyl (LM) pectin, which uses calcium instead of sugar to create a set, is good for low- or no-sugar preserves. LM pectin's will set at pH values of up to about 6.5 and require no sugar for gelation because gel formation is dependent only on the presence of Ca^{2+} , which ions are always required for gelation of LM pectin solutions. Gel strengths and gelling/setting temperatures increase as the calcium ion concentration increases. Gelling temperatures can range from 40 to 100°C (Sciencedirect.com, 2020).

Overall Aims:

The main aim of this project is to create a dish that resemble a of flavour food dish, component that uses pectin to gel at a low sugar content. Another aim is to use pure note by note compounds in the flavouring of the dish. Finally, the objective of this particular project is to create a dish that slightly resembles a no bake cheesecake and has similar textures.

Materials and methods:

Equipment used:



Machine: Blast Chiller

Make: MerCatus

Module: Y3



Gas Hob:

Make & Model: G20, 20mbar



Scales:
Make & Model:HG01046B
Silver Crest



Metal Mould & Acetate paper



Jug

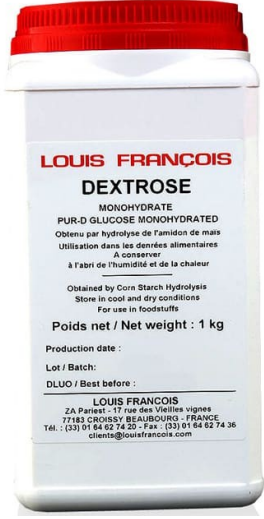



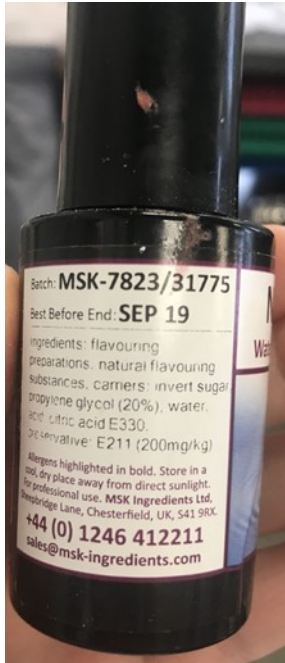
Saucepan & Pots

Ingredients:

Pectin Disk:

INGREDIENT	TYPE	QUANTITY USED
<p>Pectin</p>  <p>Ingredients of this pectin: Thickener: pectina (E440ii), sucrose, stabiliser, calcium sulphate (E516)</p>	<p>Low Sugar</p>	<p>1g</p>
<p>Sugar</p>	<p>Dextrose</p>	<p>20g</p>

		
Water	-	60ml
	Citric	1g
Flavour Compound	Mango	drop



Ingredients of this: natural flavouring substances, carriers, invert sugar, propylene glycol (20%), water, acid citric acid E330, preservative E211 (200mg/kg).

Crumb Base:

INGREDIENT	QUANTITY USED
------------	---------------

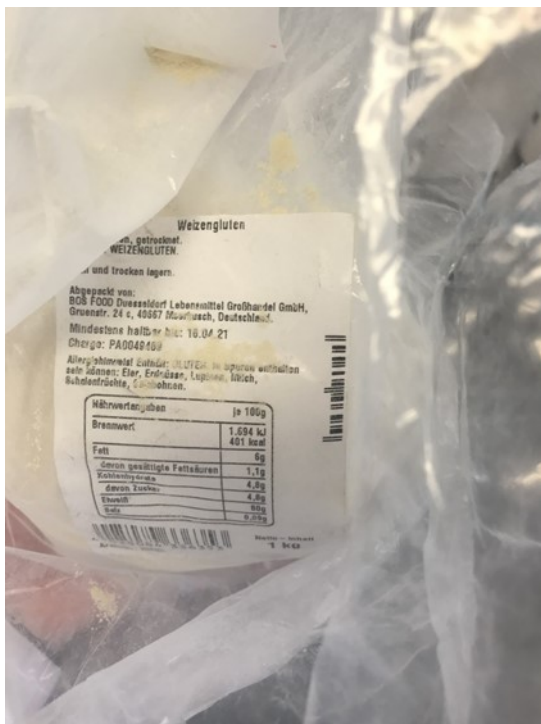
Cornflour

200g



Gluten

100g



Water

80ml

Sugar – Dextrose

10g



Flavour-Mango

Drop



Colour – Red Powder

Pinch or two

Yogurt Base:

INGREDIENT

QUANTITY USED

Yopol

60ml



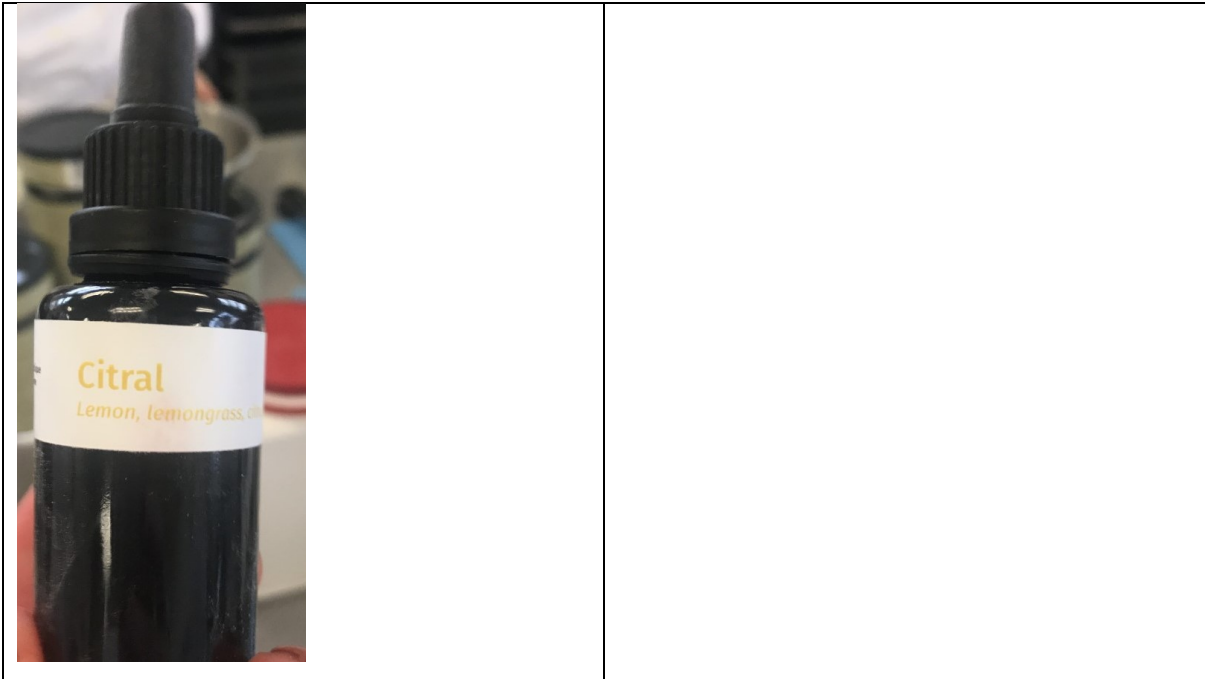
Ingredients: Hydrogenated plant fat, modified starch, sugar, milk proteins, powdered skimmed milk, acidulant: citric acid (E-330), contains lactose.

Water

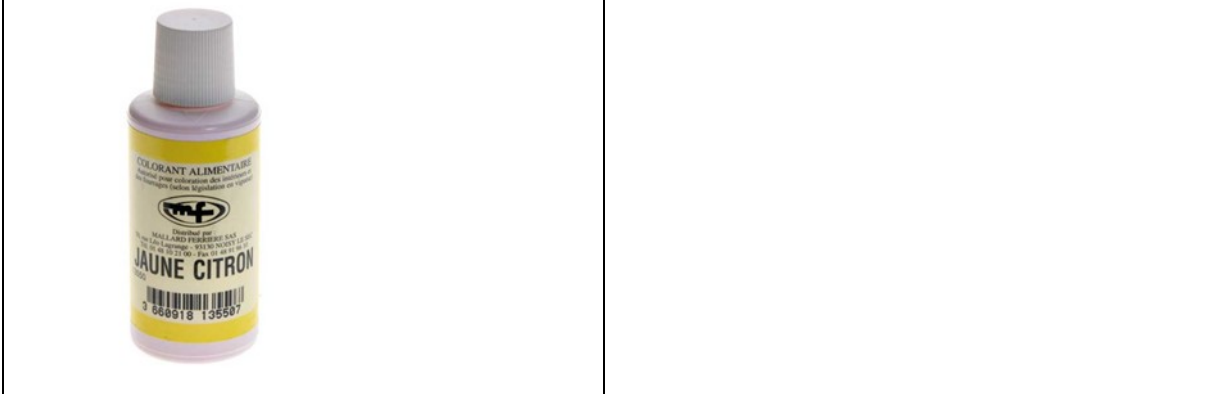
180ml

Flavour-Citral

Drop


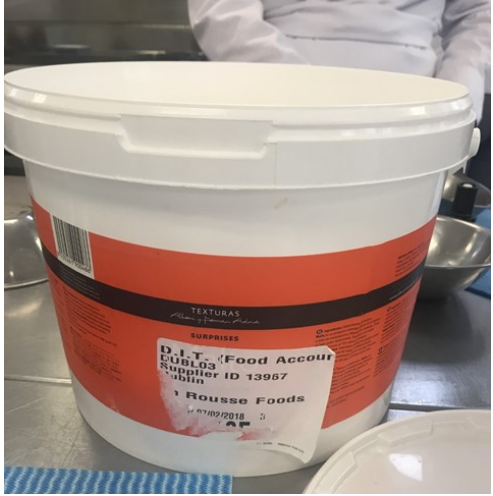
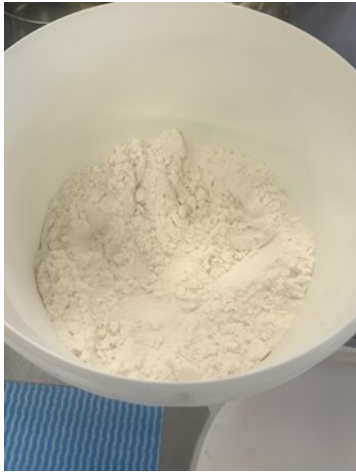


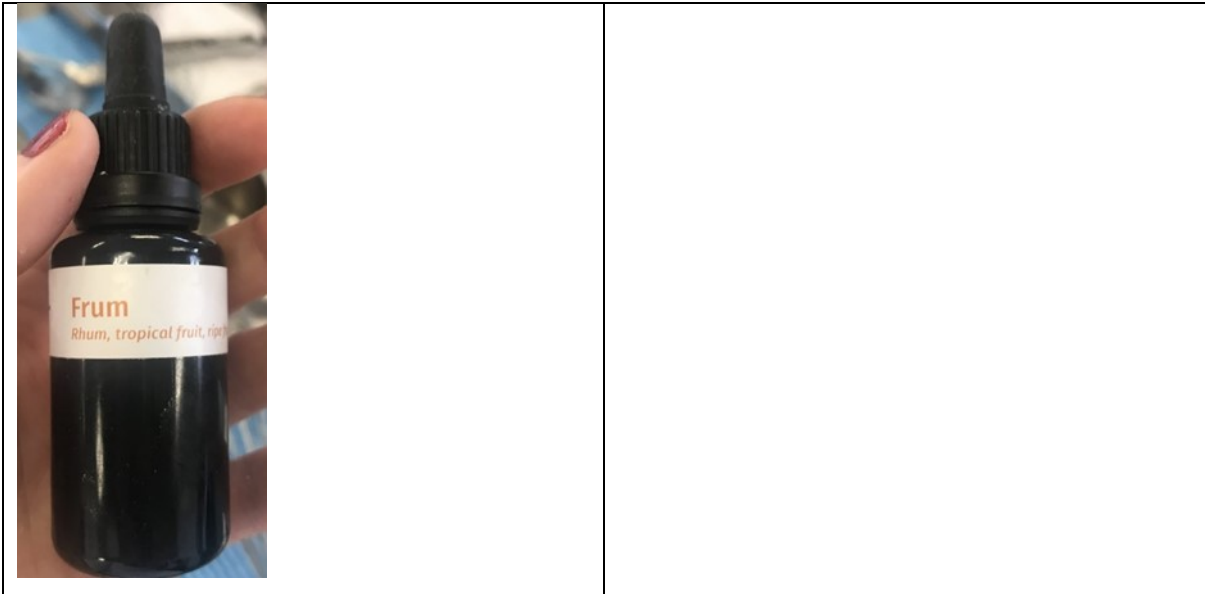
Colour-Yellow



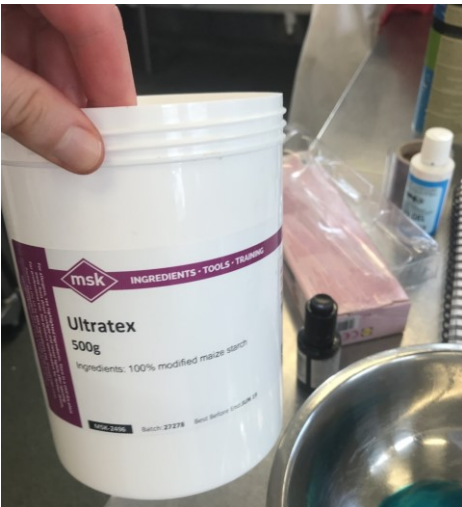
Coconut Snow:

INGREDIENT	QUANTITY USED
------------	---------------

	Coconut Oil	3Tbsp
Icing Sugar	50g	
Maltodextrin  	20 Tbsp	
Flavour -Frum	Drop	



Garnish:

INGREDIENT	QUANTITY USED
<p data-bbox="191 969 794 1008">Ultratex</p>  <p data-bbox="191 1601 794 1646">Ingredients: 100% modified maize starch</p>	<p data-bbox="794 969 1402 1008">90g</p>
<p data-bbox="191 1657 794 1713">Water</p>	<p data-bbox="794 1657 1402 1713">100ml</p>
<p data-bbox="191 1713 794 1767">Sugar-Dextrose</p>	<p data-bbox="794 1713 1402 1767">30g</p>



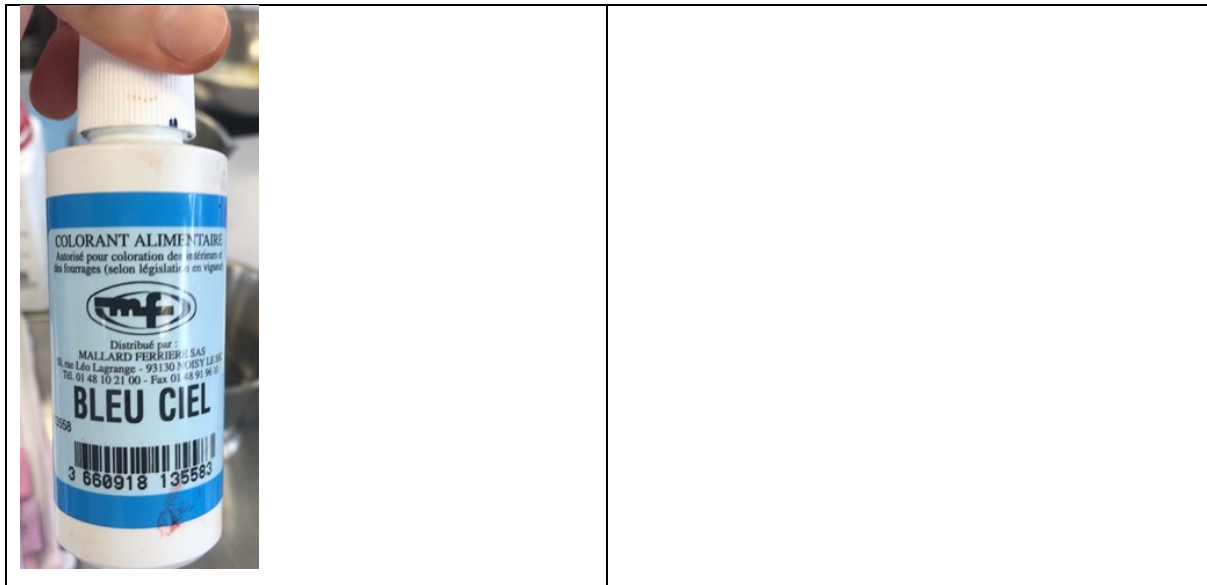
Flavour-Peaco



Drop

Colour-Blue

Drop



Final Method:

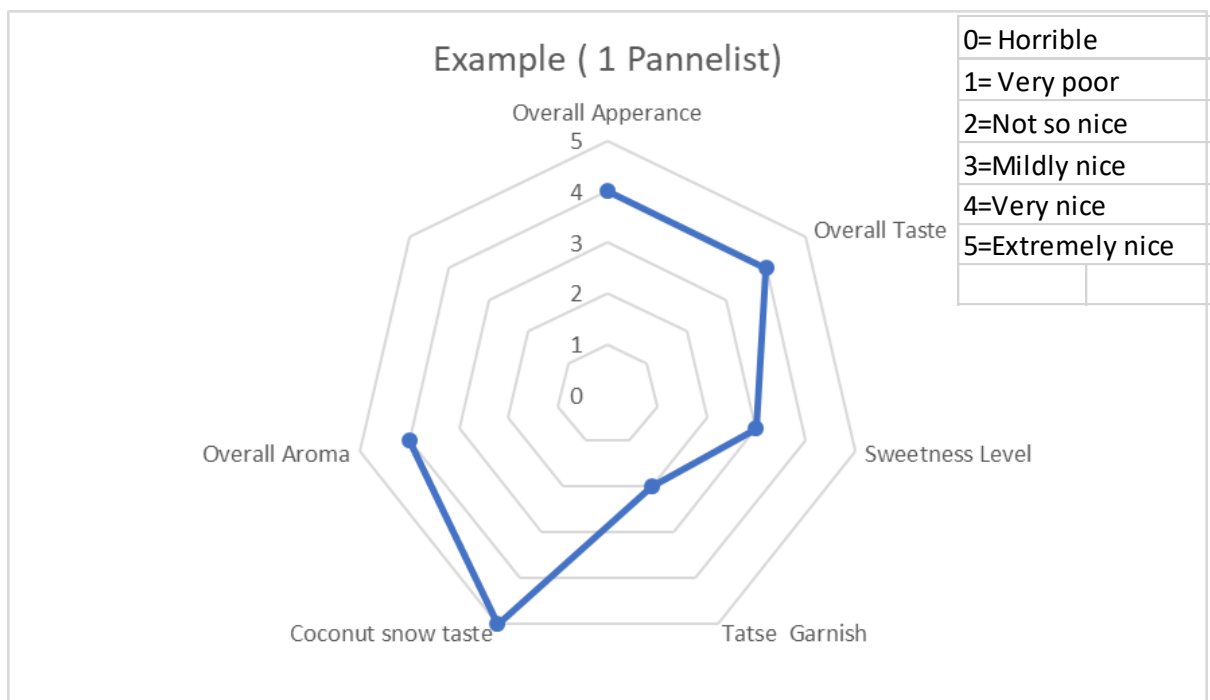
Firstly the crumb base was to be made so all needed ingredients were weighed up using the scales, each ingredient was separated in bowls before then mixing the water with red colouring in a jug, then adding this to the cornflour before adding gluten, sweetener and flavouring. This was all mixed together with hand to create a desired texture. Following this a circular mould which can be seen in equipment list was placed on a plate with a ring of acetate paper inside, then $\frac{1}{4}$ of this mould was filled with the crumb mixture. This was set to the side while the pectin dish was to be made. For this pectin dish the ingredients shown above were also weighed out corrected placed in individual bowls, jugs before then placing the pectin, acid. Sugar and water in a jug and heading to the bowl. The Mango flavour was then added, after heated the pectin mixture was poured on top of the crumb mix in the mould up to about $\frac{1}{2}$ of the mould. This was then placed in the blast chiller for about 15 mins while the cheesecake base was to be made. As for the base, the ingredients were also gathered, weighed and separated into bowls, then the yopoh and water were mixed together following this the lemon flavour of Citral and colouring was added. A spoon full of this mixture was then placed into the blast chilled mould of base and pectin dish, and it was let set in blast chiller once again for further 10-15 minutes. While this was being set the coconut snow was prepared, all ingredients once again gather and weighed, then the oil was melted in a pot over a medium heat on the gas hob before being added to icing sugar. After this addition the maltodextrin was added as well as the Frum flavour before being sieved into a bowl before serving. Finally, a garnish was made to accompany the dish, this involved gathering ingredients listed above and weighing them, following this the water was mixed with blue

colouring and added to the ultratex before adding the note by note flavouring. This was then set aside before serving. Once the main dish was set the mould and acetate paper was removed and the garnish was spoons along the plate along with the coconut snow sprinkled on to improve the overall appearance of the cheesecake textured dish. A sensory evaluation was then taken of the final dish. For this final sensory a QDA was prepared and carried out.

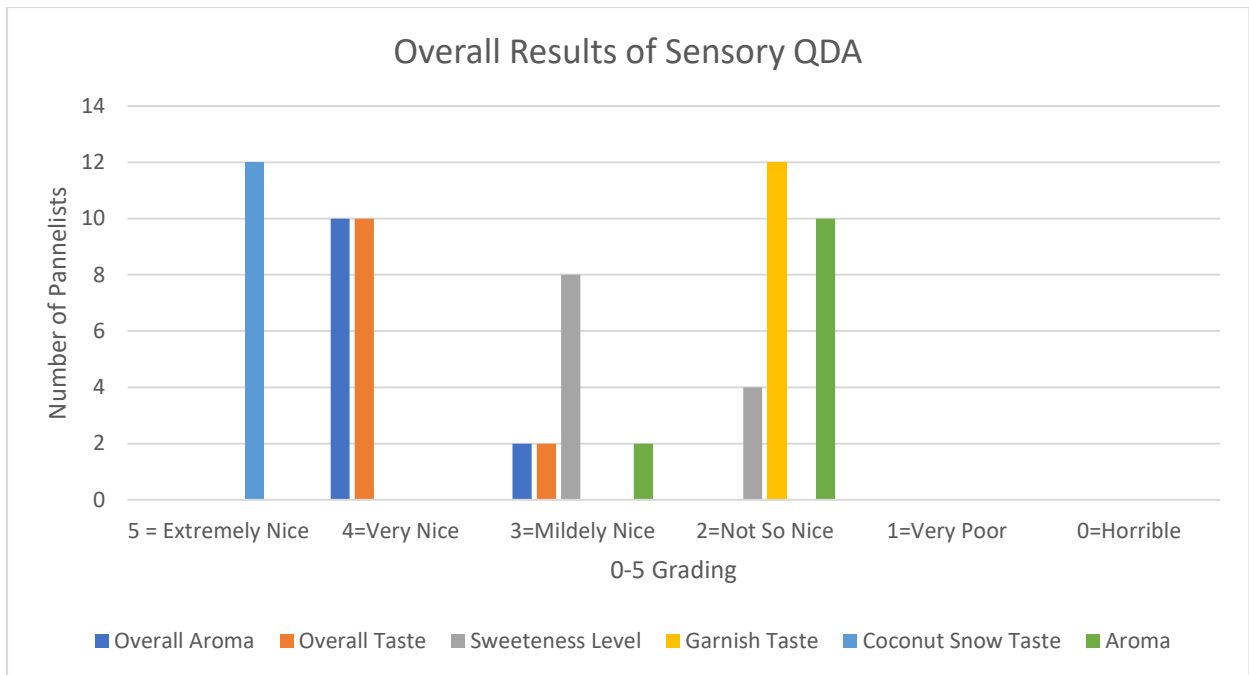
Results:

Firstly, the results of the overall sensory evaluation

Figure 1.4 below displays an example of a completed QDA from one for the panellist



The bar chart Figure 1.6 below displays the overall scored of the QDA grading carried out.



The results clearly convey that the garnish was the weakest element of the dish with all 12 panellists grading it low, while the coconut snow element was appetising and appealing with all 12 panellists grading it extremely nice, the aroma of the dish clearly showed a dislike also. However, these results also show an overall like for the taste and appearance of the dish. As well as this the results displayed that the pectin mix gelled well with the low sugar concentration as it set nicely and could be incorporated into the dish.

The images below display the completed dish throughout the week leading up to the final week.



Setting of pectin disk on the crumb base after completion of week 2.





The following weeks final food product which involved a creation of base of the dish sitting on the pectin disk and crumb base.



The final completed food dish served up with accompaniments



Discussion:

Based on the results of the sensory provided it was clear that the overall mix of aromas could have been improved, however if the dish is to be broken down into aromas of separate sections, the mango aroma stands out the most as this gives off a tropical light taste, followed by this is was clear to see the lemon aroma of citral popping out along with the powering taste of the yogurt powder, this lemon is of citral compound and has slightly kick of lemongrass (Lemongrass oil contains 70–80 percent citral). This light sweet aroma along with the creamy texture of the base represented the texture of a cheesecake base. The aroma of rum with a hint of tropical fruit (In relation to this flavour Frum mainly rum with fruity

taste comes about as there are a whole range of ester compounds found in rum; they're often the dominant class of organic compounds found in the spirit, the range of esters adds the fruitiness to rum's aroma; particularly important contributors are ethyl propanoate which contributes a caramel-like, fruity aroma (Compound Interest, 2020)) alongside the dish gave a nice alternative flavouring especially when incorporated with the sweetness of icing sugar. In relation to the results of the base, its crumbly texture was achieved through the use of the starch and gluten allowed for an accurate representation again of a bottom base of a cheesecake. This particular aroma was too strong until it was tasted along with the pectin disk. The pectin disk gelled at the desired texture that would not be too sticky in the mouth, although this pectin disk was at a low sugar concentration the citric acid and flavours compensated for this. As for citric acid which is approved as a food additive which EU legislation defines them as "any substance not normally consumed as a food in itself and not normally used as a characteristic ingredient of food, whether or not it has nutritive value, the intentional addition of which to food for a technological purpose in the manufacture, processing, preparation, treatment, packaging, transport or storage of such food results, or may be reasonably expected to result, in it or its by-products becoming directly or indirectly a component of such foods." (European Commission - European Commission, 2020). As for the maximum limit of Citric Acid (E330) permitted in pectin, jelly type food stuff according to Directive 79/963/EEC³ it is defined as quantum satis (as much as is sufficient) (Irishstatutebook.ie, 2020). As for the permitted levels of pectin, the level is also defined as quantum satis. Following this the maltodextrin used as part of this overall dish helped achieved the powder like texture that was wanted. Maltodextrin is a white, starchy powder that manufacturers add into many foods to improve their flavour, thickness, or shelf life, it is a very easy to digest carbohydrate and can provide energy rapidly. Maltodextrin is considered not harmful and has no stated maximum permitted level however it has show links with type two diabetes when consumed in excess (Medical News Today, 2020). Following this it is clear that dextrose gives aspects of this overall food dish a desirable taste of sweetness. Dextrose is the name of a simple sugar that is made from corn and is chemically identical to glucose, or blood sugar. It has a caloric value of 4 kcal/g. There is a maximum permitted limit of 15mg/kg for dextrose in food (Fao.org, 2020).

Conclusion:

To conclude overall these results indicated a powering aroma of fruitiness throughout the dish while achieving a desired cheesecake like texture and appearance while incorporating a low sugar concentration pectin solution od desires gelling texture.

Appendices:

Log Book:


Week 1:

Aims:

The main aim of this week is to determine what quantity of which pectin sets and with what appropriate quantity of sugar, water and acid. Another aim is to play around with note by note flavours and determine which ones are best to use.

Materials & Methods:

Trial 1 Below using Fruit Pectin

INGREDIENT	TYPE	QUANTITY USED
<p data-bbox="204 931 288 965">Pectin</p> 	<p data-bbox="683 931 751 965">Fruit</p>	<p data-bbox="1045 931 1082 965">3g</p>



Ingredients of Fruit Pectin:
 Thickener: amidated pectin (E440ii), salt: disodium diphosphate (E450i), dextrose, antioxidant: tricalcium phosphate (E341iiii).

Sugar



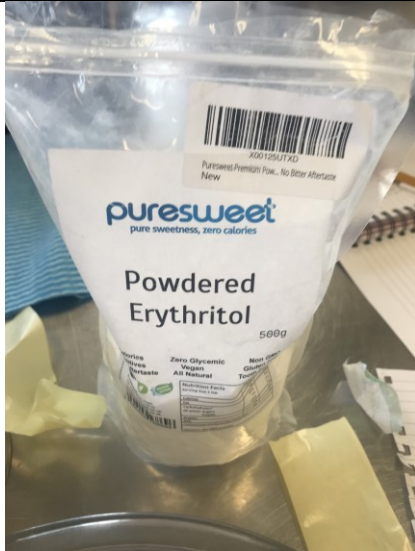
Dextrose

15g

Sweetener

Powered erythritol

2g



Ingredients of this: Carbohydrates
100g (polyols)

Acid




Citric

0.5g

Water

-

100ml

	Flavour compounds	Peaco	Drop
---	----------------------	-------	------

Trial 2 using Low Sugar Pectin:

INGREDIENT	TYPE	QUANTITY USED
------------	------	---------------

Pectin



Ingredients of this pectin:
Thickener: pectina (E440ii),
sucrose, stabiliser, calcium
sulphate (E516)



Low Sugar

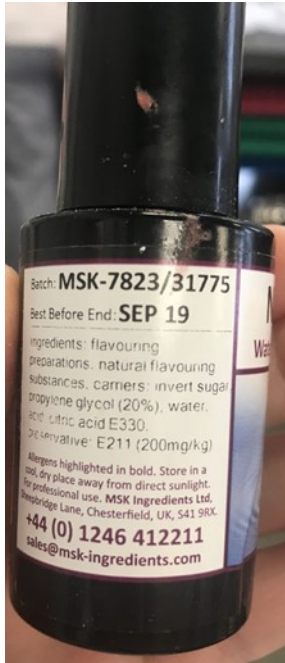
1g

Sugar

Dextrose

20g

		
Water	-	60ml
	Citric	1g
Flavour Compound	Mango	drop



Ingredients of this: natural flavouring substances, carriers, invert sugar, propylene glycol (20%), water, acid citric acid E330, preservative E211 (200mg/kg).

Methods for trail 1 & 2:

Trial 1 involved using the ingredients listed previously. Firstly, for this method the various ingredients were weighted out correctly. The pectin, acid, and sugar were all added to the

water and this water was heated to the boil then the peach flavour was added before then pouring onto a tray and observing the results over next few minutes. Following this the ingredients for trial 2 were used following the exact same method.

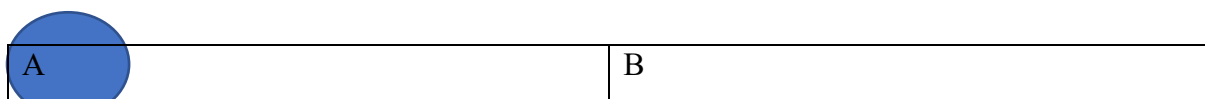
Results:

The results observed for the trial 1 using the fruit pectin were that the pectin did not set/gel properly and the texture produced could not be used in the final dish that is to be created. The flavour of Peaco used here tasted acceptable but was not the desired flavour to be used. As for trail 2 using the low sugar pectin, this gelled nicely and the flavour of mango used was desirable. The decision of which flavoured to be used was determined after a simple sensory of the gel was done where 11/12 preferred the mango. Sensory Testing is displayed below.

Below displays a Paired Preference test done by classmates (panel = 12) on flavour and texture. Trial 1 was coded B and trail 1 was coded B

Which Flavour is Preferred:

Each panellist circled the sample they preferred based on flavour, example is shown below:

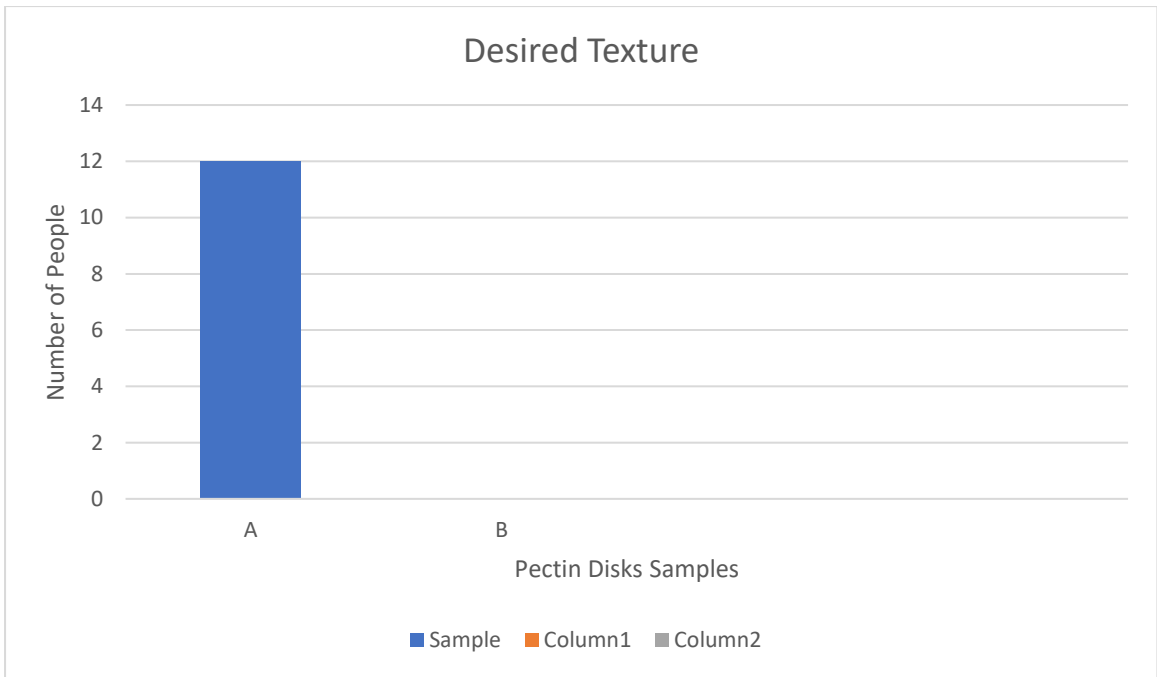
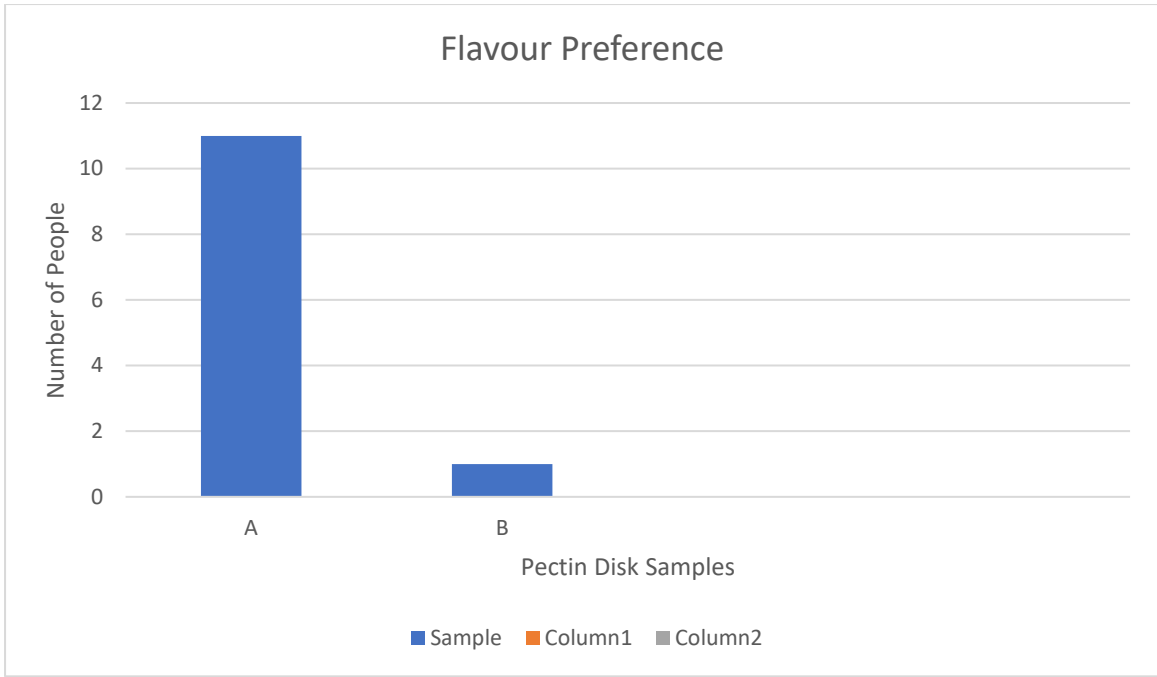


A	B
---	---

The same method of a paired preference test for the preferred texture was carried out also and

Figure 1.2 shows a chart conveying the overall chosen results.

Figure 1.1 Below shows a chart of all 12 panellist results:



Following these results the image below displays the process of heating the pectin mix for both trials





Recommendations for next week:

Following this week, the recommendations for next is to play around with more flavours what could be tasteful to use for the final dish and to stick to low sugar pectin if incorporating to any other aspect of the food dish. Another recommendation for next week is to use this pectin mix as part of the base of the dish and see if it looks acceptable when it's to be a part of this base.

Week 2:

Aims:

The main aim of this week is to create the base of my dish which is to design a crumble like textured base with pectin gel placed on top. Another aim is to determine which flavour and colouring is best suited for this base.

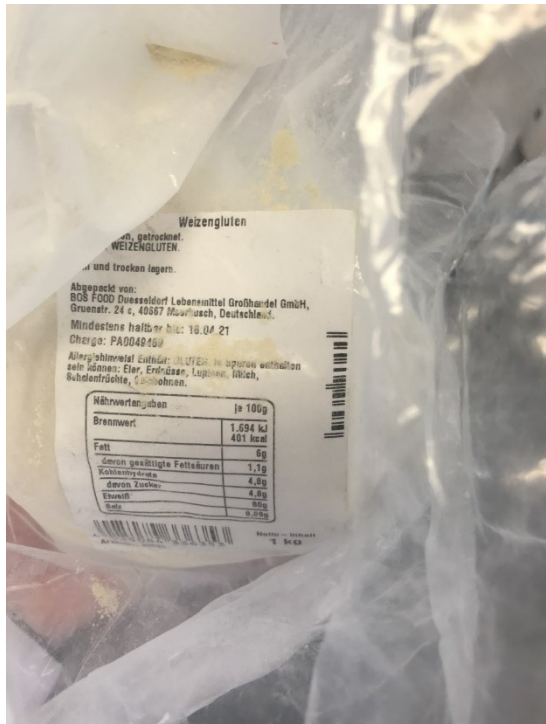
Materials & Methods:

Trail 1

INGREDIENT	QUANTITY USED
Cornflour	100g



100g



Gluten

Water

100ml

Sugar – Dextrose

10g



Flavour-Frum

Drop




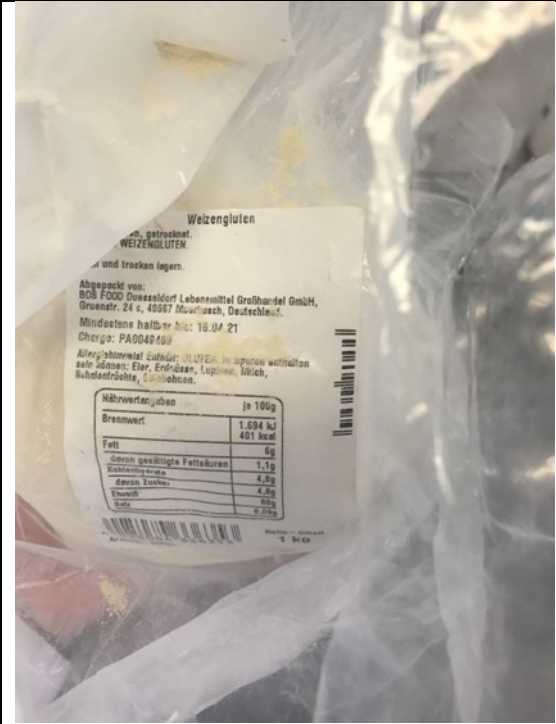
Colour-Red Powder

Pinch



Trial 2:

INGREDIENT	QUANTITY USED
<p data-bbox="204 409 336 443">Cornflour</p> 	<p data-bbox="810 409 879 443">200g</p>
<p data-bbox="204 1366 295 1400">Gluten</p>	<p data-bbox="810 1366 879 1400">100g</p>



Water

80ml



Sugar – Dextrose

10g



Flavour-Mango

Drop

		
	<p>Colour – Red Powder</p>	<p>Pinch or two</p>

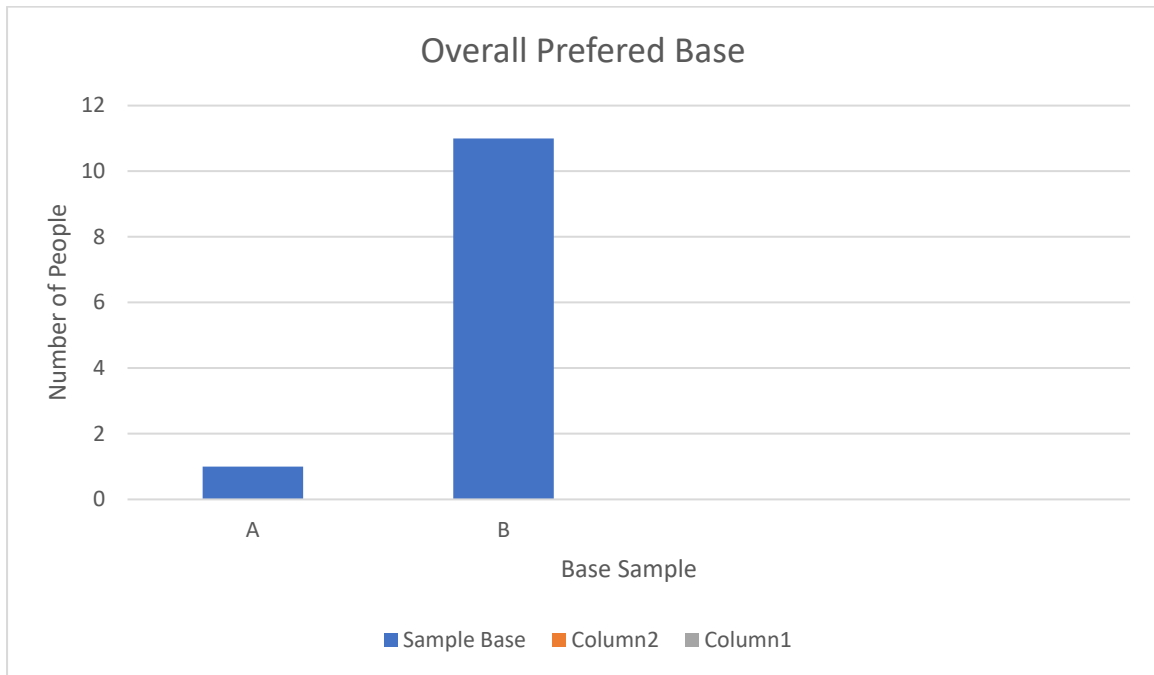
Methods for trail 1 & 2:

Firstly, all needed ingredients were weighed, trial 1 was done first where corn-starch was added with gluten, dextrose, Frum flavour and water before then putting in a pinch of red powder. This was mixed together and placed around acetate paper in a circular mould before then pouring the pectin mix from week 1 on top and letting set in blast chiller for 10 minutes. Following this Trial 2 was carried out using similar method expect a different flavour was used as well as adding colouring to the water before mixing in, this was also placed in a mould with pectin solution poured on top.

Results:

Another sensory analysis was done on most overall preferred crumb base following a paired preference test once again whereas Trial 1 was A and Trial 2 was B. Figure 1.2 will display a chart with breakdown of results. The results showed that B was preferred overall. After the production of both crumbs bases it was clear that Trail 2 resulted in a crumblier texture which is what was desired rather than the sticky texture of Trial 1.

Figure 1.2



This image displays the Trial 1 results of the crumb base





This image above displays Trial

with pectin solution on top in its mould before being set



While this image to the left shows the Trial one base with pectin solution on top after setting.



This image to left shows Trial 2 crumb base before moulded.

Recommendations for next week:

Following this week, I recommend using this as the overall crumb base with pectin solution on top followed by light textured cheesecake base for next week to sit on top. I also recommend keeping the dish in blast chiller for longer then 10 minutes to allow a more solid setting of the bottom.


Week 3:



Aims:

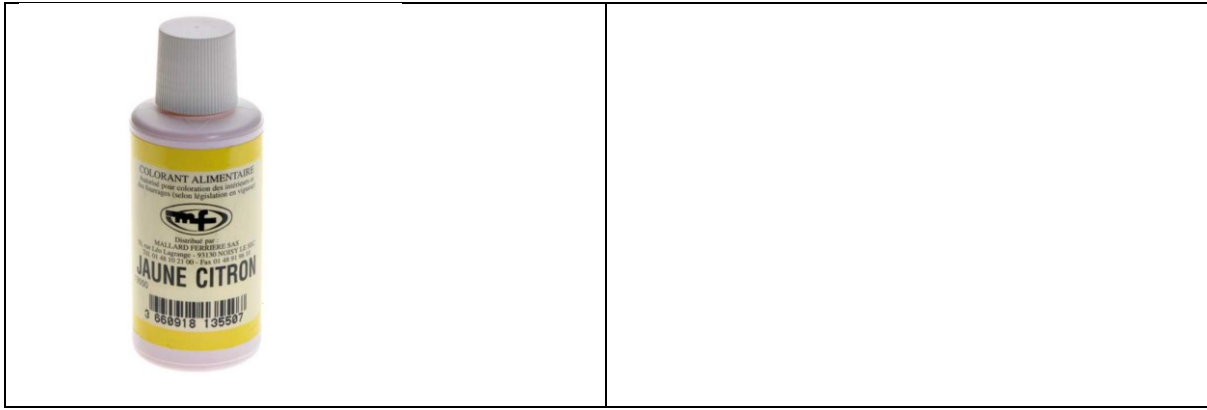
The main aim of this week is to create a tasteful yogurt like base for centre of the cheesecake dish. Following this another objective is to play around with flavour for creation of coconut snow and a garnish for dish.

Materials & Methods:


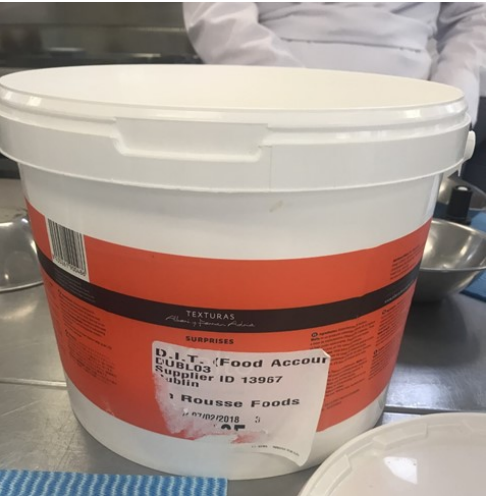
Middle Base of the overall dish:

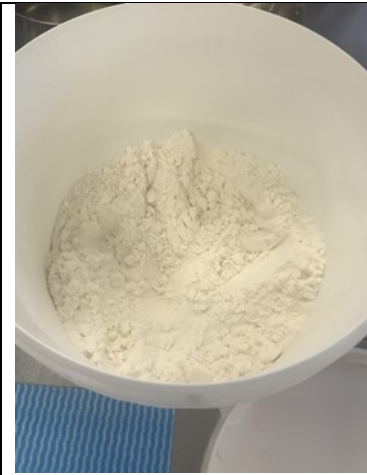
INGREDIENT	QUANTITY USED
<p data-bbox="204 1064 288 1099">Yopol</p> <hr data-bbox="204 1115 571 1120"/> 	<p data-bbox="810 1064 879 1099">60ml</p>

 <p>Ingredients: Hydrogenated plant fat, modified starch, sugar, milk proteins, powdered skimmed milk, acidulant: citric acid (E-330), contains lactose.</p>	
<p>Water</p>	<p>180ml</p>
	<p>Drop</p>
<p>Colour-Yellow</p>	



Coconut Snow:

INGREDIENT	QUANTITY USED
	<p>Coconut Oil</p> <p>3Tbsp</p>
<p>Icing Sugar</p>	<p>50g</p>
	<p>Maltodextrin</p> <p>20 Tbsp</p>



Flavour -Frum



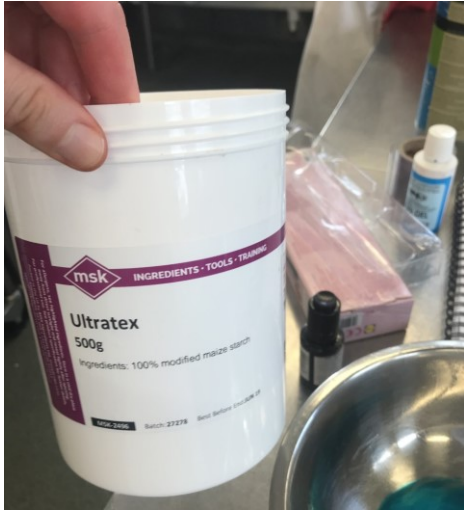
Drop

Garnish:

INGREDIENT	QUANTITY USED
------------	---------------

Ultratex

90g



Ingredients: 100% modified maize starch

Water

100ml

Sugar-Dextrose



10g

.....



Flavour-Peaco

Drop

	
<p>Colour-Blue</p> 	<p>Drop</p>

Method:

Firstly, the yogurt like base was developed by weighing ingredients and then mixing the yopol with the water until desired texture was achieved then adding the flavour of citral and colouring. Then following this the method for the desired recipe of week 1 pectin mixture

along with weeks 2 crumb base was made and this yogurt like base was placed on top while still in mould, this was all then placed in blast chiller for 15-20 minutes.

While this was setting the coconut, snow was made by firstly melting the oil in pan until liquid then adding this to the icing sugar before adding maltodextrin and Frum flavour and finally sieving the mixture so that it appears like snow. As well as this a simple garnish made by mixing a flavour of peaco with blue colouring and ultratex and water. After the various recipes were carried out a sensory evaluation was also done.

Results:

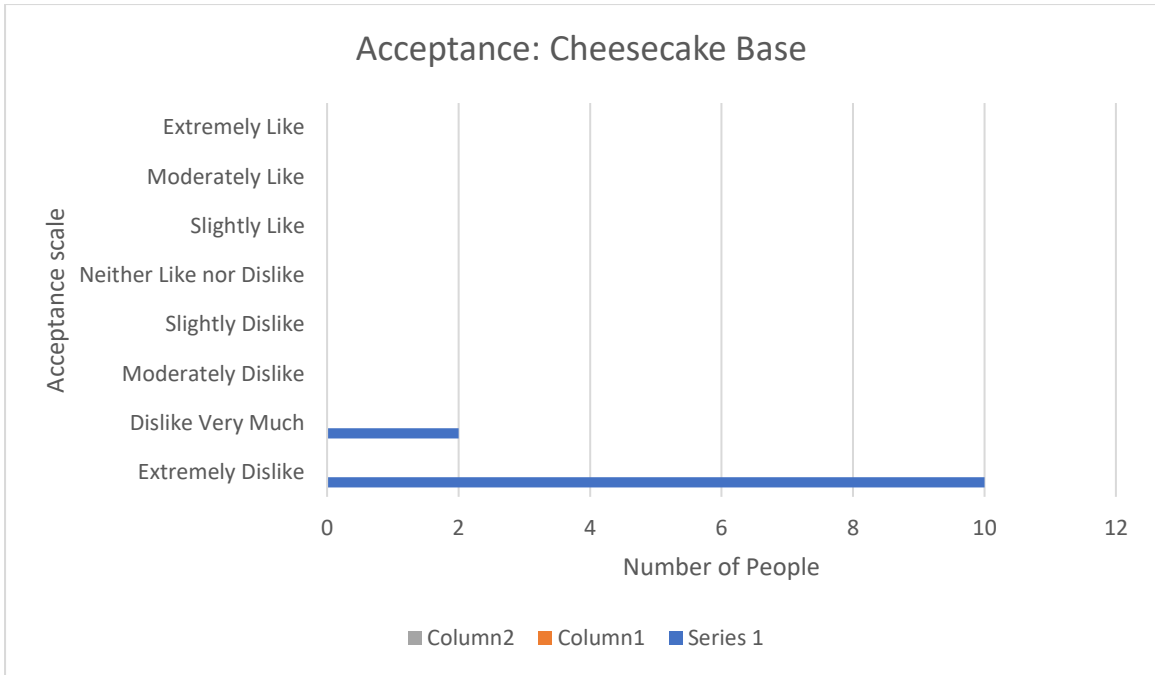
The results of the cheesecake base were a light creamy texture and a nice yogurt lemon taste. The sensory test carried out was an acceptance test using a hedonic scale where results showed 10 panellists' ticked extremely liked box and 2 ticked liked very much. An example is shown below. Figure 1.3 displays a chart with overall results carried out by the panellists (panel of 12). The results of the garnish displayed a desired texture and colour however was not sweet enough, as for the coconut snow a desired texture and flavour was achieved.

Hedonic Scale Acceptance Test:

Sample 351

- Like extremely
- Like very much
- Like moderately
- Like slightly
- Neither like nor dislike
- Dislike slightly
- Dislike moderately
- Dislike very much
- Dislike extremely

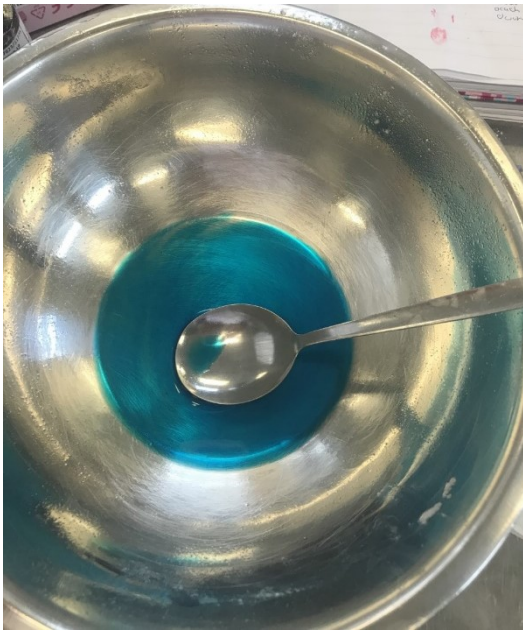
Figure 1.4



This image to the left shows the yopoghurt and water mix with flavour added as well as a slight yellow colouring.



This image displays the coconut snow mixture being sieved.



This image to the left displays the water mixed with blue colouring.

While the image to the right shows the water, colouring mixed with ultratex.





This image here displays the crumb base topped with pectin gel and yogurt like base after its been moulded in blast chiller before serving.



Recommendations:

For next week the final week I recommend for the garnish that addition of sugar is needed to improve the sweetens, as well as this I recommend the use of the same recipes already established to complete the overall dish.

WEEK 4:

This week can be seen in the project written above the appendices.

References:

- Compound Interest. (2020). The Chemistry of Rum. [online] Available at: <https://www.compoundchem.com/2015/11/12/rum/> [Accessed 1 Jan. 2020].
- European Commission - European Commission. (2020). Press corner. [online] Available at: https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_480 [Accessed 1 Jan. 2020].
- Fao.org. (2020). [online] Available at: http://www.fao.org/tempref/codex/Meetings/CCFAC/ccfac33/fa01_07e.pdf [Accessed 1 Jan. 2020].
- Iqemus. (2020). The 24 notes - Iqemus. [online] Available at: <https://iqemus.com/en/the-24-notes-note-by-note-cooking/> [Accessed 1 Jan. 2020].
- Irishstatutebook.ie. (2020). S.I. No. 128/1997 - European Communities Detailed Provisions on the Control of Additives, Other Than Colours and Sweeteners For Use in Foodstuffs) Regulations, 1997. [online] Available at: <http://www.irishstatutebook.ie/eli/1997/si/128/made/en/print> [Accessed 1 Jan. 2020].
- Kovac, K. (2020). Molecular Gastronomy – The Food Science. [online] Splice. Available at: <https://splice-bio.com/molecular-gastronomy-the-food-science/> [Accessed 1 Jan. 2020].
- Scienceofcooking.com. (2020). What is Molecular Gastronomy?. [online] Available at: https://www.scienceofcooking.com/molecular_gastronomy/ [Accessed 2 Jan. 2020].
- Medical News Today. (2020). Maltodextrin: What it is, dangers, and substitutes. [online] Available at: <https://www.medicalnewstoday.com/articles/322426.php#is-maltodextrin-safe> [Accessed 1 Jan. 2020].
- Sciencedirect.com. (2020). Pectin - an overview | ScienceDirect Topics. [online] Available at: <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/pectin> [Accessed 20 Dec. 2019].