Advanced Molecular Gastronomy TFCS9025 2022-23

FIPDes Food Innovation and Product Design

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1) Introduction

Molecular gastronomy can be defined as the application of scientific knowledge in culinary practices. Its beginnings date back to 1969 with the field of “The Physicist in the Kitchen” by the physicist Nicholas Kurti and then the research “Molecular and Physical Gastronomy” by the chemist Hervé This (Sanchez, 2016). As will be described in the further development of this report, the molecular gastronomy focuses on the physical and chemical changes that occur while cooking.

One of the important principles of molecular gastronomy is to respect the ingredients and their natural form, finding techniques to modify classic recipes. This exploration has also relationship between the senses and food in all different sectors, where this field is increasing its prominence. Food production is one of the primary sectors, and is in this sector that one of the main problems lies, food waste. According to FAO (2022) 39% of wastage occurs in the food manufacturing industry. therefore the ambition is to develop sustainable and innovative processes to valorize food by-products.

In general, studies highlight that agro-food wastes are still a rich source of bioactive compounds, like phenolic compounds, antioxidants or fatty acids and their recovery could be economically attractive (Precup, et.al, 2017). The valorization of agro-industrial wastes with molecular gastronomy represents a potential answer this global challenge.

One trend of the molecular gastronomy discipline can answer to the raising need exposed, Note by note cuisine. This does not use food as meat or vegetable but instead compounds. It´s a technique and a science where characteristics as shapes, colors, tastes, odors and temperatures has to be design (This, 2013). In the following report, the development of a note-by-note dish is explored.

2) Aim and objectives

Aim

Combine the scientific understandings and knowledge of physical and chemical properties of food and its exploration in cooking, focusing primarily on the use of pure compounds in order to tackle the problem of food waste.

Objectives

- Use the Note by note cooking technique by using pure to near pure compounds in the composition of the dish, relating it to the challenge of food waste.
- Ensure that each element of the dish is safe to be consumed.
- Using molecular gastronomy techniques to produce an attractive dish.

3) Materials and methods

The components of the plate could be divided in four elements. The ingredients of each are listed below:

Table No. 1 Foam formulation

Ingredient	Formulation (w/w)	Supplier
Water	70.81%	N/A
Sugar	19.27%	N/A
Egg white protein	9.63%	Sosa
Xantham gum	0.24%	Sosa
Orange flavour	0.05%	MSK

Table No.2 Spheres formulation

Ingredient	Formulation (w/w)	Supplier
Water	66.79%	N/A
Fructose	13.80%	Sosa
Glucose syrup	8.90%	Belgosuc
Blackberry flavour powder	6.23%	Sosa
Ascorbic acid	2.00%	India France
Calcium lactate	1.47%	Sosa

Xantham gum	0.67%	Sosa
Black colorant	0.13%	Sweet stamp

*The bath used was made with water and 0.5% of sodium alginate brand Sosa.

Table No.3 Tuile formulation

Ingredient	**Formulation (w/w)**	**Supplier**
Water	87.98%	N/A
Corn flour	9.12%	Gem
Gluten	1.61%	Spiegelhauer
Salt	1.07%	N/A
Colorant	0.21%	Mallard ferrière

Sunflower oil was used fo fry the tuiles

Table No.4 Isomalt basket formulation

Ingredient	**Formulation (w/w)**	**Supplier**
Isomalt crystals	99.50%	Belgosuc
Yellow colorant	0.50%	Mallard ferrière

In addition to the raw materials, the following elements were used:

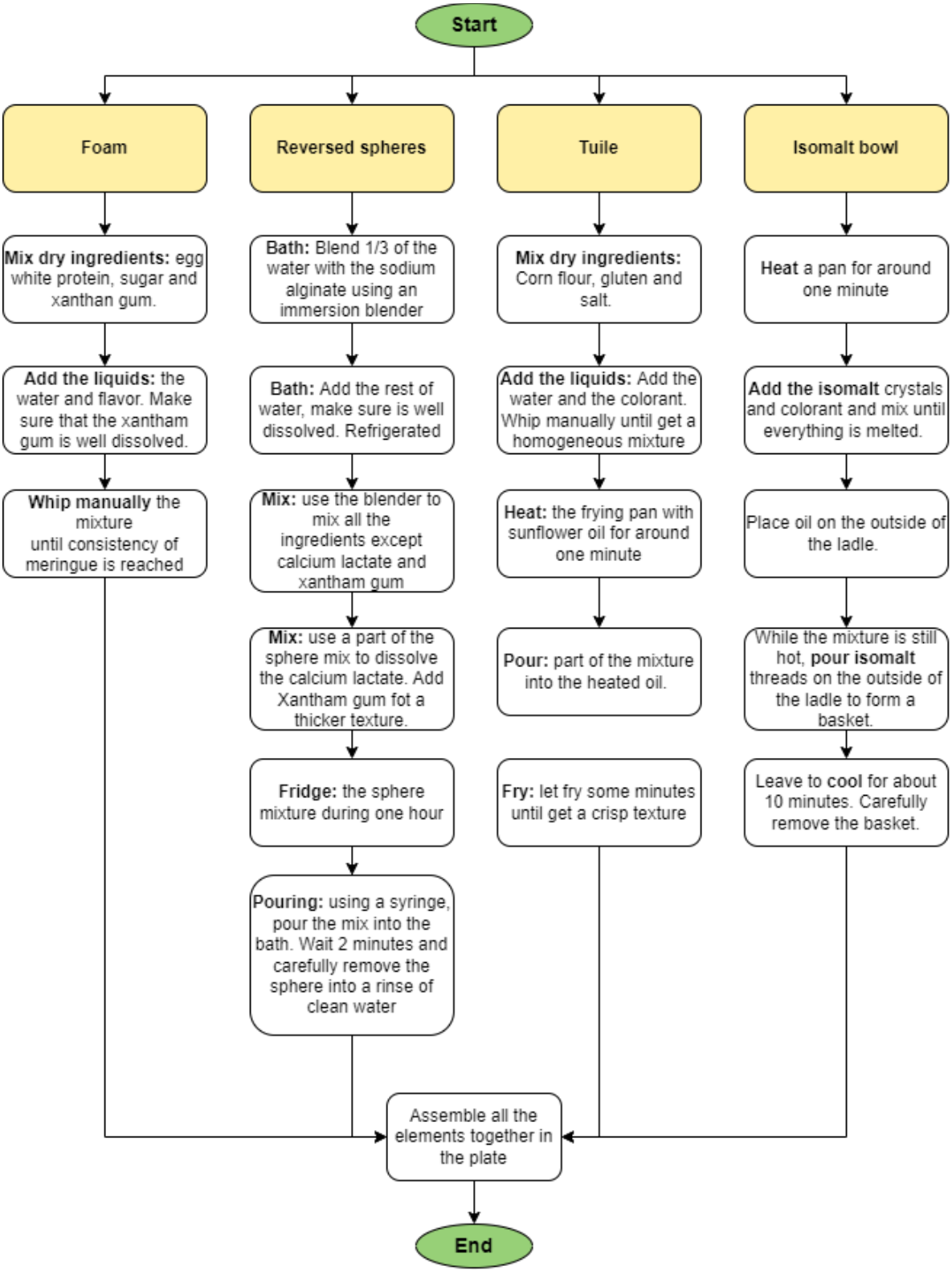
Materials:

- Stainless steel wire whisk
- Bowls
- Spoons
- Slotted small spoon
- Syringe
- Frying pan
- Cooking pot
- Vogue ladle

Equipment:

- Camry Black Digital Kitchen Scale
- Inmersion blender. VEVOR 650 Watt 250mm

Figure No.1 General method for the elements of the plate



(Lavelle et al.,2021)

4) Results and discussion

In the Figure No.2 the final dish is presented. It can be divided in four elements: Tuiles, cascara, foam and spheres.

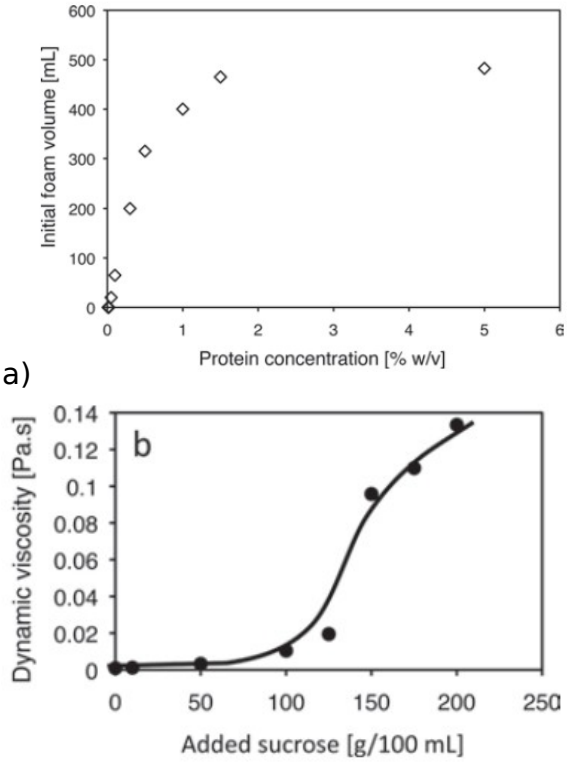
Figure No. 2 Note Fiambre

The foam is the greater element of this plate. A foam is a dispersed system, two incompatible phases, water and air, are mixed together by dispersing one phase (air) into the other (water). In this preparation the egg white protein acts as a surfactant, the xantham gum increases the viscosity of the interface and the sugar can increase the volume of the liquid phase and also increases the viscosity (Lavelle et al.,2021).

When working with foams, the instability the is a factor to be considered. Naturally the foam tend to increase in bubble diameter thereby reducing their total interfacial area, this is due to the difference in density of the various phases but the constitution and physical properties of the disperse phases phase plays an important rol (Vega César et al., 2013).

In the product the disperse phase was mainly stabilized with egg white proteins. The formation of liquid foam is enabled by letting proteins adhere at the bubble interface, and let them act as a barrier between them. Figure 3a shows the action of this type of protein. Even with low concentrations, less than 1%, it is possible to achieve high foam volumes. On the other hand, Figure 3b shows that the addition of sugar increases the viscosity of the liquid phase, which is important to prevent coalescence.

Figure No.3 Egg white foam behavior



a). Volume vs. egg white protein concentration b). Foam viscosity vs. added sucrose

*100 ml of water were used

(Vega César et al., 2013).

In this product, the development of a stable foam was especially important, the use of protein and the increase of viscosity with sugar and xantham gum were important for this.

Figure No.4 Natural color of corn tuiles

Table No. 5 Tuiles composition

Different tuiles composition		
a) 	**b)** 	**c)** 
Water 65.74% Oil 25.90% Corn flour 5.78% Gluten 1.39% betroot 1.00% salt 0.20%	Water 90.53% Corn flour 6.58% Gluten 0.41% betroot 1.65% Salt 0.82%	Water 87.98% Corn flour 9.12% Gluten 1.61% Salt 1.07% Colorant 0.21%

Further, the tuiles follows the structure of tempura-type coatings. The batter is normally made of only wheat flour and water, but in this case, to use mostly pure compounds, gluten and corn flour were used. Regarding the process, this liquid batter comes into direct contact with the hot oil, which makes it coagulate, forming a crispy crust. In this frying process, several changes take place, such as gelatinization of starch, denaturation of protein, and reduction of moisture (is that dehydration that provides a crispy texture) (Vega César et al., 2013).

In the Table No. 5 different tuiles compositions are presented. It is possible to observe that the different compositions mainly of corn flour and water, produced different textures. It can be observe the behaviour explain by Xue and Ngadi (2007) increased levels of corn resulted in high crispness due to decreased moisture retention. This is also directly related to the water content, in the Figure a, the oil was added to the batter mixture, this slowed down the evaporation of the water and thus the mixture became burnt instead of crisp.

In figure b, using oil out of the mixture, a better structure is observed. However, the tuile was brittle, this is attributed to a high water content but a lower corn flour and gluten content that increases its water retention. Finally, in figure c, the correct proportion was achieved. A higher corn flour content requires more energy for gelatinisation, preventing the mixture from burning.

Moreover, the salt has also a function in the matrix. The sodium chloride (NaCl) works as a flavor enhancer and a batter stabilizer. But also rise the starch gelatinization temperatures (Xue and Ngadi, 2007), an important factor in this experiment to prevent the sample from burning.

In the Figure No.4 a tuile with no colorants is presented. The yellowish color observed is due to the carotene pigment in the corn (Xue and Ngadi, 2007), and was used as source of natural yellow color.

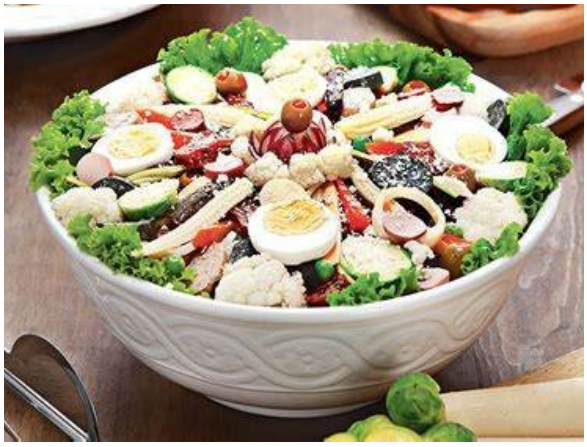
Regarding the spheres, a reverse spherification technique was used. This consists of submerging a liquid with a mixture of calcium lactate in a bath of sodium alginate. The long-lasting jell is form because calcium acts like a bridge between chains of alginate, enhancing their interactions and favoring gelation. This mechanism is call the eggbox model (Vega César et al., 2013). In this case, a reverse technique was used because the sphere results with a thicker membrane than with basic spherification, allowing an easier manipulation.

Having laid out the technical behavior of the elements of this dish, it is also important to consider the inspiration. Figure No.5 shows a photograph of the Guatemalan cold meat. This is a cold dish that consists of a mixture of all kinds of sausages and vegetables, served especially during the Day of the Dead festival. This dish was the inspiration for the project because it reminds us that

regardless of its shape, size or maturity, all vegetables can be included in a dish, this must be part of our culture in order to reduce food loss.

In the presented dish some of the ingredients have the potential to come from waste from other industries. Such as blackberry or beetroot extracts, this indicates that in general the note-by-note cooking trend within the discipline of molecular gastronomy has the potential to be extended to the use of waste from the food industry.

Figure No.5 Guatemalan Fiambre



5) Conclusions

The presented dish is a sample of what note by note cooking can achieve through molecular gastronomy techniques. In the preparation of the elements of this dish, mostly pure compounds were used, with the exception of corn flour, which is mostly amylopectin. Conforming to the molecular gastronomy definition, scientific knowledge was apply in culinary practices. Each element of the dish used different techniques such as foaming, reverse spherification, coagulation, and frying. The dish is meant to be reminiscent of a Guatemalan

dish in which a mix of different vegetables and cheeses are placed on a decorate traditional dish every 1rs. november. Remembering that we must avoid wasting food and that every food can be included in our dishes. In addition, some of the elements that were used come from by-product extraction techniques from other industries. What has been demonstrated in this project indicates that the application of this trend of molecular gastronomy can be extended to counteract the problem of food waste.

6) References

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7) Logbooks

MODULE CODE: TFCS9025 2022-23

MODULE TITLE: Advanced Molecular Gastronomy

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

Objective:

Testing different formulations of pure compounds to obtain a tuile.

Aims:

Replace the wheat flour with a mixture of maize flour and gluten.

Determine the correct cooking method for tuiles as well as the best formulation.

Materials and Method (Ingredients, Equipment and Method)

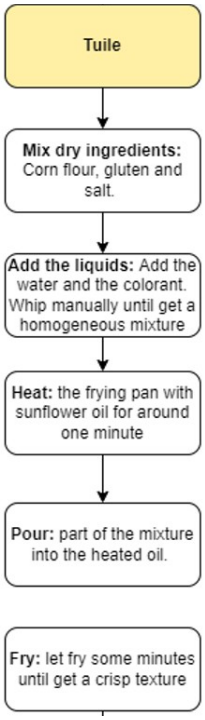
Ingredients

Water	330g
Oil	130g
Corn flour	29g
Gluten	7g
betroot	5g
salt	1g

Equipment

- Spoon
- 2 stainless steel bowls
- Frying pan
- Steel wire whisk

Method



Results and discussion

During this week of experimentation, different tuile formulation tests were carried out to replace wheat flour with pure or almost pure compounds such as maize flour. The factors to be considered were the heat transfer for water evaporation, the water retention of the mixture and the water content of the mixture. These three factors were important when considering the best way to obtain a tuile and affected its crispness. It was found that increasing the maize flour and gluten content improved water evaporation.

Conclusions

The best formulation was found to be the one with 1.6% gluten, which strengthened the texture to make it crunchier.

The colouring content must be high so that it is retained even after cooking.

Recommendations for following week

Consider the consistency of the tuile mixture.

Heat the pan before adding the oil so that the tuile does not burn.

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

Objective:

Reverse spherification of a sweet blackberry mixture that will serve as a main course element.

Aims:

- Assess the necessary viscosity of the mixture to ensure that the spheres will keep for several days.
- Evaluate the amount of flavouring to be used as well as the colouring.

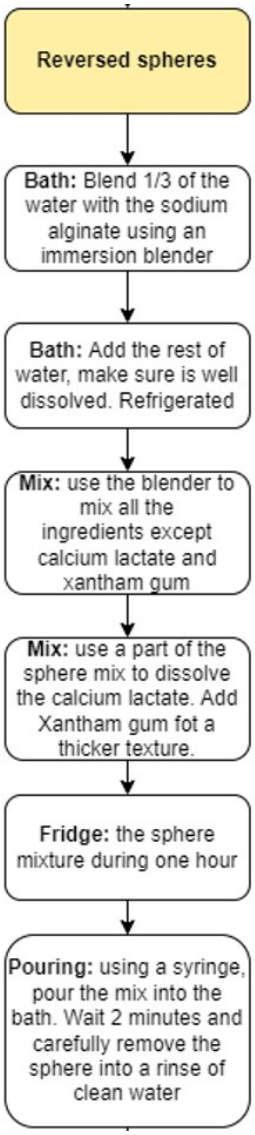
Materials and Method (Ingredients, Equipment and Method)

- Water 150g
- Fructose 31g
- Glucose syrup 20g
- Blackberry flavour powder 14g
- Ascorbic acid 4.5g
- Calcium lactate 3.3g
- Xantham gum 1.5g
- Bath of sodium alginate at 0.5%

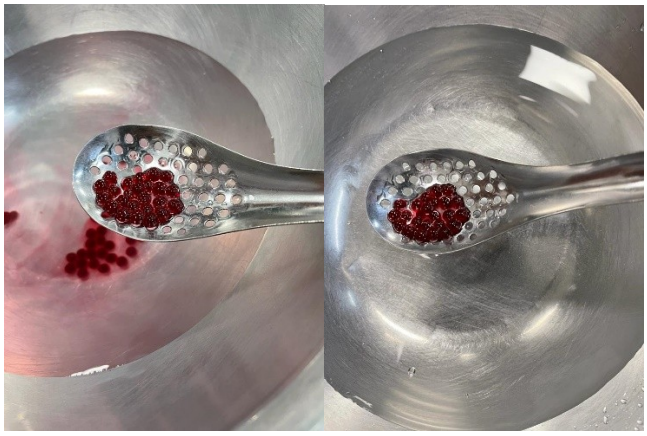
Materials and equipment

- Spoon
- 2 stainless steel bowls
- Frying pan
- Steel wire whisk
- Personal scale
- Immersion blender

Method



Results and discussion



During this laboratory, a reverse spherification was tested. During the tests it was determined that a higher addition of flavouring and colouring was

necessary. The addition of xantham gum worked well in the mixture as the spheres did not stick together and were not brittle.

Conclusions

- Tests have shown that it is recommended to use at least 6% blackberry powder for a sufficiently strong flavour.
- The addition of xantham gum to the mix for the spheres will allow them to keep longer.

Recommendations for following week

- It is recommended to use a stronger dye for the manufacture of this element in the final week.

Objective:

Use isomalt glucose to make a beetroot-flavoured circular shape.

Aims:

- Develop another tuile test to check that the formulation is correct.
- Determine the correct process and composition of a glucose isomalt tuile.

Materials and Method (Ingredients, Equipment and Method)

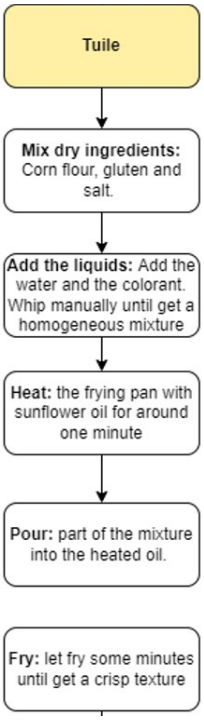
Ingredients

- Water 82g
- Corn flour 8.5g
- Gluten 1.5g
- Salt 1g
- Colorant 2g
- Isomalt glucose 30g
- Beetroot powder 2.5g

Materials and equipment

- Spoon
- 2 stainless steel bowls
- Frying pan
- Steel wire whisk
- Personal scale
- Immersion blender

Method



Results and discussion

An unsatisfactory test of a tuile made of isomalt glucose was carried out during this laboratory. As can be seen in the photographs, the water loss was not as expected and therefore it stuck to the plate. The taste was good, however further tests should be carried out to modify the formulation.

Conclusions

- The tuile using isomalt glucose was not satisfactory because the expected moisture loss was not achieved.
- The corn flour and gluten formulation defined above was satisfactory, resulting in a crispy tuile.

Recommendations for following week

It is recommended to add a flavouring to the corn and gluten flour tuile.

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

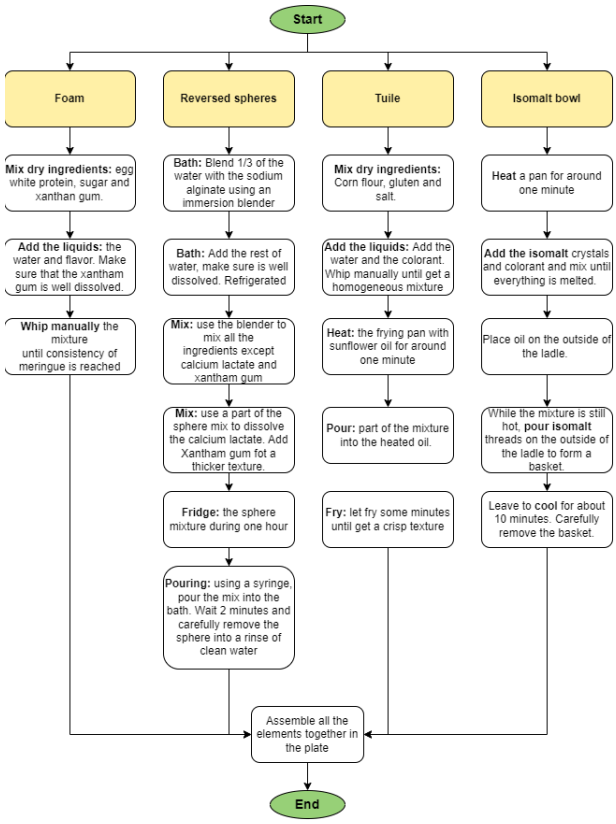
Objective:

Develop the four elements of the final dish and bring them all together.

Aims:

- Developing the foam using egg protein and sugar
- Use isomalt crystals to make the base of the dish

Materials and Method (Ingredients, Equipment and Method)



Ingredients

- Corn flour 8.5g
- Gluten 1.5g
- Salt 1g
- Colorant 2g
- Isomalt crystals 30g
- Yellow colorant 0.1g
- Fructose 31g
- Glucose syrup 20g
- Blackberry flavour powder 14g
- Ascorbic acid 4.5g
- Calcium lactate 3.3g
- Xantham gum 1.5g

- Bath of sodium alginate at 0.5%
- Sugar 40g
- Egg white protein 20g
- Xantham gum 0.5g
- Orange flavour 0.1g

Materials:

- Stainless steel wire whisk
- Bowls
- Spoons
- Slotted small spoon
- Syringe
- Frying pan
- Cooking pot
- Vogue ladle

Equipment:

- Camry Black Digital Kitchen Scale
- Inmersion blender. VEVOR 650 Watt 250mm

Results and discussion

This was the last session. In this practice the four elements of the dish were developed. It can be seen that a stable foam was achieved that can be contained by the isomalt basket. The elements of the tuile and the spheres complement the plate.

Conclusions

- The best way to use isomalt to make a base for a dish is to weave in strands of it while it is still hot.
- This results in crisp, brightly coloured tuiles that add an artistic touch to the dish.

Recommendations for following week

- It should be assessed how long the foam will be stable.