



*ADVANCED
MOLECULAR
GASTRONOMY*

TFCS9025

D17123650 - DT415/2

XYNADA EUGENIA


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1.Introduction

1.1 What is Molecular Gastronomy

Molecular gastronomy, is the scientific subject which is connected to the physical and chemical transformations that occur during cooking.

At the beginning Molecular gastronomy was introduced under the name *molecular and physical gastronomy* and later shortened to *molecular gastronomy* in 1988 by Hervé This, a physical chemist, and Nicholas Kurti, a professor of physics at the University of Oxford, who were interested in the science behind the facts that occur during the cooking processes. Even though food science had existed for some centuries, its focus had been on the chemical composition and on the industrial production and nutritional properties of food. Molecular gastronomy, on the other hand, focuses on the mechanisms of transformation that occur during culinary processes, an area that had historically tended to rely heavily on tradition. Molecular gastronomy seeks to open the way to new knowledge on the basis of the chemistry and physics behind culinary processes.

The purpose is to introduce new ways of cooking that are rooted in science. These techniques are called molecular cooking, and the new culinary style based on such techniques is called molecular cuisine (This & Myhrvold, encyclopaedia Britannica).



Picture 1. Dessert

Molecular gastronomy developed very quickly after its creation in 1988. None of the tools used in food labs or ingredients, was present in cookbooks as recently as the 1980s. Indeed, it was an objective of Kurti and This to rationalize culinary activity as well as to modernize it (for example, to improve the efficiency of some traditional heating systems, in which the energy loss regularly reached 80 percent).

1.2 Note by Note Cuisine

Note by note cuisine was first introduced in 1994 (in the magazine *Scientific American*) at a time when Herve This started using compounds in drinks and dishes, such as paraethylphenol in wines and whiskeys; 1-octen-3-ol in sauces for meat; limonene; tartaric acid; and ascorbic acid among others. The initial proposal was to improve food, but as a next step was to create dishes entirely from compounds.

Note by note cuisine does not use meat, fish, vegetable or fruits to make dishes, but instead uses compounds, either pure compounds or mixtures. For the various parts of the dish in note by note cuisine, the cook has to design the shapes, the colors, the tastes, the odors, the temperatures, the trigeminal stimulation, the textures, the nutritional aspects and more.

The feasibility of this new cuisine has already been shown. On 24 April 2009, the French chef Pierre Gagnaire, showed the first note by note dish to the international press in Hong Kong. Then, in May 2010, two note by note dishes were shown by the Alsatian chefs Hubert Maetz and Aline Kuentz at the French-Japanese Scientific Meeting in Strasbourg. However the first note by note meal was not served until October 2010, by chefs of the Cordon Bleu School in Paris, to the participants of the 2010 courses at the Institute for Advanced Studies in Gastronomy. On 26 January 2011, at a banquet before the launching event of the International Year of Chemistry at the United Nations Educational, Scientific and Cultural Organization, Paris, a whole note by note meal for about 150 people was served by Potel et Chabot Catering Company. This meal was again served in April 2011 to about 500 chefs receiving Michelin stars in Paris. And since the number of note by note initiatives is becoming too big to be tracked (This, 2013).



Picture 2. Future Kitchen

1.3 Diracs & Cocktails

Dirac, is named after the British theoretical physicist Paul Dirac. The preparations named "diracs" are systems that want to have the same type of nutritional properties that muscle tissue (meat, fish), but they are much more varied.

2. Aim

The aim of this assignment is the creation of a dish including:

- 1 dirac that will have the same nutritional value with a muscle tissue (meat or fish), but with varied shape, color, smell, taste and texture using only compounds,
- 1 cocktail using only compounds.

3. Materials & Methods

3.1 The Concept

The dish's name is "Irish Breakfast in the forest" and represents a typical Irish breakfast (Pork sausage, eggs, beans, bacon) with reach fruity flavors that we can meet in a forest, and one Bloody Mary cocktail.

Table 1. Diracs' Protein content

Type	Protein content
Pork Sausage	20%
Egg white	11%
Egg yolk	16%
Bacon	37%
Beans	5%

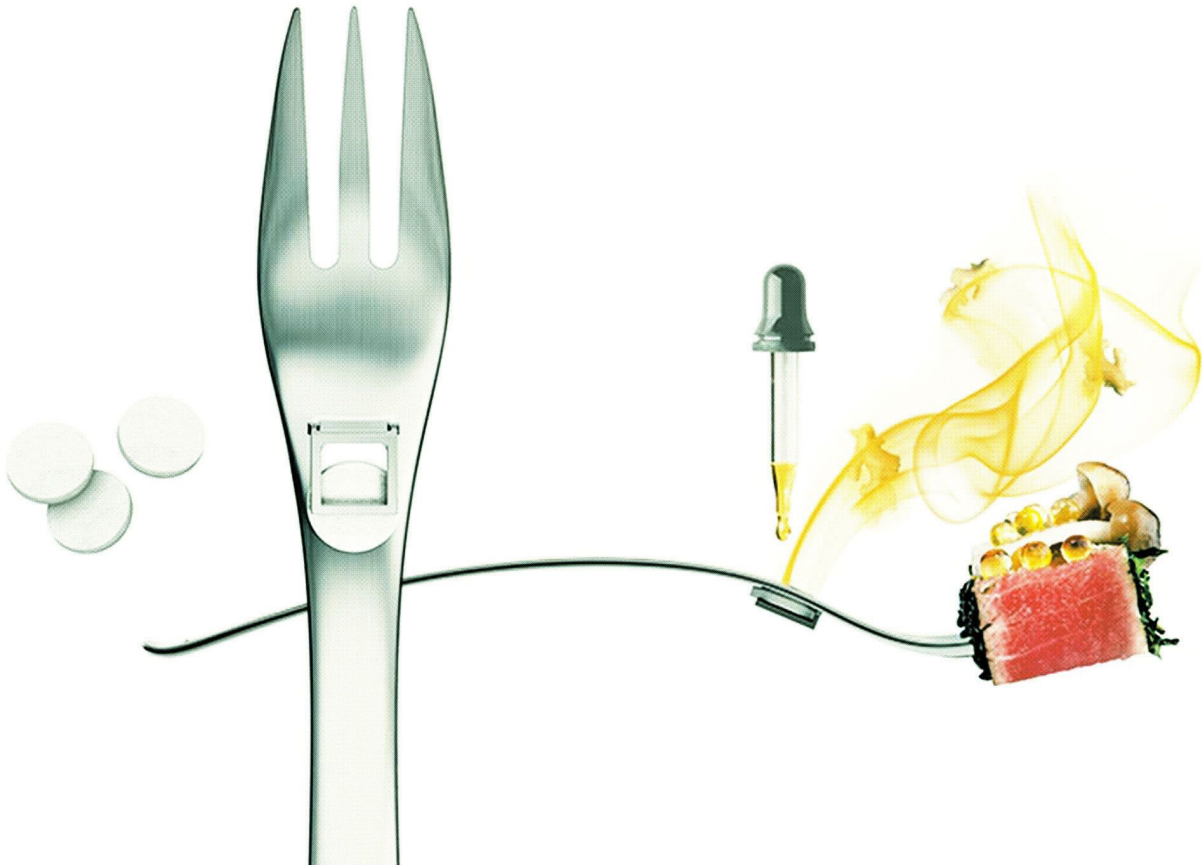
3.2 Compounds

- Water
- Hydrolysed Collagen Peptide Unflavored (Myprotein)
- Agar powder (Texturas Albert y Ferran Adria)
- Lecite (Texturas Albert y Ferran Adria)
- Potato starch (La Rouse Foods Limited)
- Sucrose
- Sodium Chloride
- Sunflower oil
- Blanc color (Mallard Ferriere) E170, sodium sulfate chloride
- Bronze color (msk) E141, sodium sulfate chloride
- Red color (Mallard Ferriere) E129, sodium sulfate chloride
- Yellow color (Mallard Ferriere) E110, E102, sodium chloride, sodium sulfate
- Lemon Flavouring (msk) citronellyl acetate
- Orange flavouring (msk) Octyl acetate
- Spiced Apple lavournig (msk) Pentyl pentanoate
- Vodka flavouring (Sosa Alphabet flavours) ethyl lactate & ethyl acetate

- Tomato flavouring (Sosa Alphabet flavours) cis-3- Hexenal
- Yogurt flavouring (Sosa Alphabet flavours) Acetaldehyde
- Chili flavouring (Sosa Alphabet flavours) Hexanal

3.3 Equipment

- Excalibur Food Dehydrator
- Braun Hand blender



3.4 Methods

3.4.1 *Egg white*

Recipe:

In 89gr H₂O we add 11 gr of our protein, ½ teaspoon Agar & 1 teaspoon sugar We boil the mixture for 3 minutes and then we add ¼ teaspoon white color and 2 drops of yogurt flavor. We wait 2 minutes and we transfer it to our plate. We wait until it gets solid.



Picture 3. Egg white

3.4.2. *Egg Yolk*

Recipe:

In 84gr H₂O we add 16 gr of our protein, ½ teaspoon of Agar & 1 teaspoon of sugar. We boil the mixture for 3 minutes and then we add ¼ teaspoon yellow color and 2 drops of spiced apple flavor. We wait 2 minutes and we transfer it to our plate on top of the white mixture. We wait until it gets solid.



Picture 4. Egg yolk

3.4.3. *Pork Sausage*

Recipe:

In 80gr water we add 20 gr of our protein, $\frac{1}{2}$ teaspoon Agar & 1 teaspoon sugar. We boil the mixture for 3 minutes and then we add $\frac{1}{4}$ teaspoon red color and 2 drops of orange flavoring. We wait 2 minutes and we transfer it to a silicone mould. We wait until it gets solid.



Picture 5. Pork Sausage

3.4.4. *Beans*

Recipe:

In 95 gr water we add 5 gr of our protein, $\frac{1}{2}$ teaspoon Agar & 1 teaspoon sugar. We boil the mixture for 3 minutes and then we add $\frac{1}{4}$ teaspoon bronze color and 2 drops of lemon flavoring. We wait 2 minutes and we transfer it to a silicone mould. We wait until it gets solid.



Picture 6. Beans

3.4.5 Bacon

In 250 ml of water we add 2 tablespoons potato starch & 1 teaspoon sugar. We transfer 63 gr of our mixture to a pot and we add 37 gr of protein . We boil it until it forms to a gel. We add ¼ of tablespoon red color and 2 drops of lemon flavor.. We transfer it to a papersheet and we put it in a dehydrator for 2 ½ hours x 135 °F. We fry the flakes it sunflower oil.



Picture 7. Bacon

3.4.6 Bloody Mary Cocktail

In 100 ml of water we add 1 pinch of salt, 2 drops of red color, 2 drops of vodka flavor, 2 drops of chili flavor, 2 drops of tomato flavor & 1 teaspoon of lecithin. Using hand blender, we stir the mixture for 2 minutes.



Picture 8. Bloody Mary

3.4.7 *Final Dish*



Picture 9. Final Dish

4. Results

Week 1



Picture 10. Egg white & Egg yolk

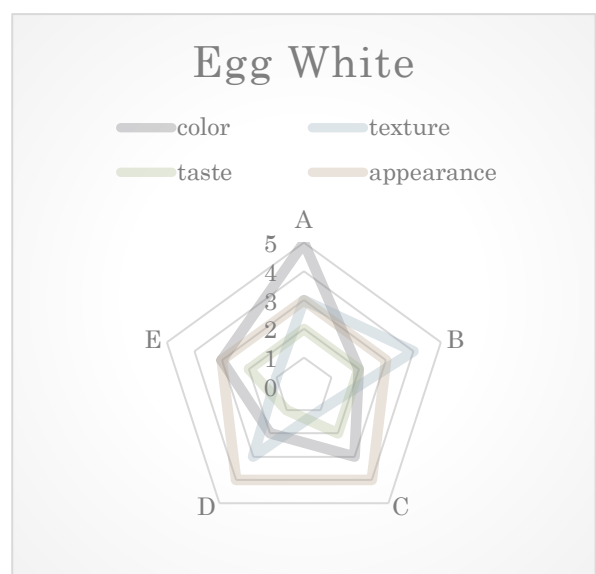
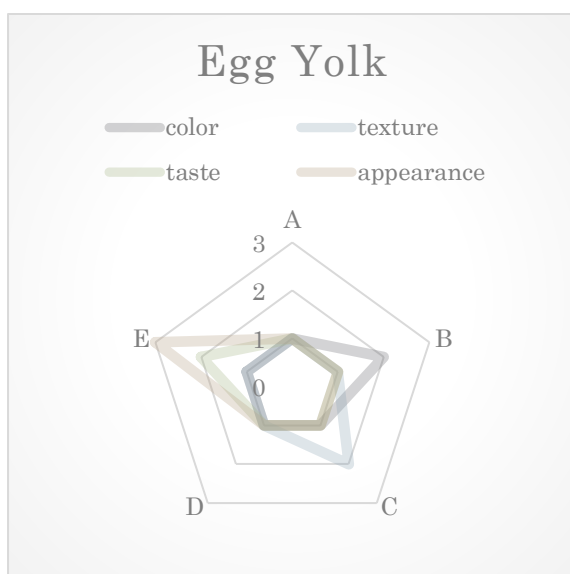
Sensory Evaluation

The team evaluated the products using a scale 1 to 5 (poor to good).

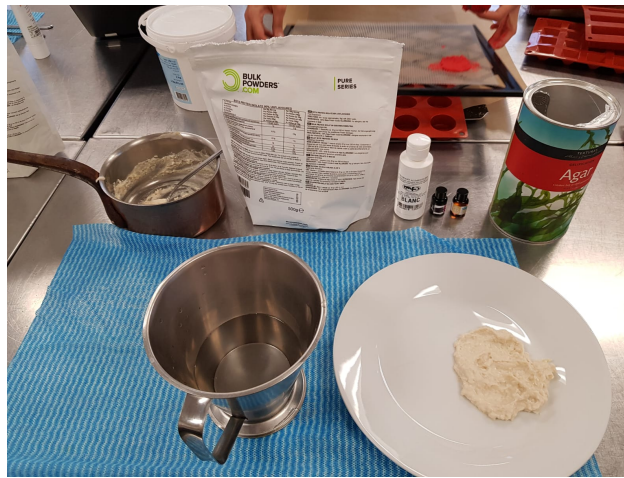
Table 2. Sensory Evaluation Sheet

Evaluator	Color	Texture	Taste	Appearance
A/B/C/D/E				

Radar Plot1.Sensory evaluation for egg yolk - Radar Plot 2.Sensory evaluation for egg white



Week 2



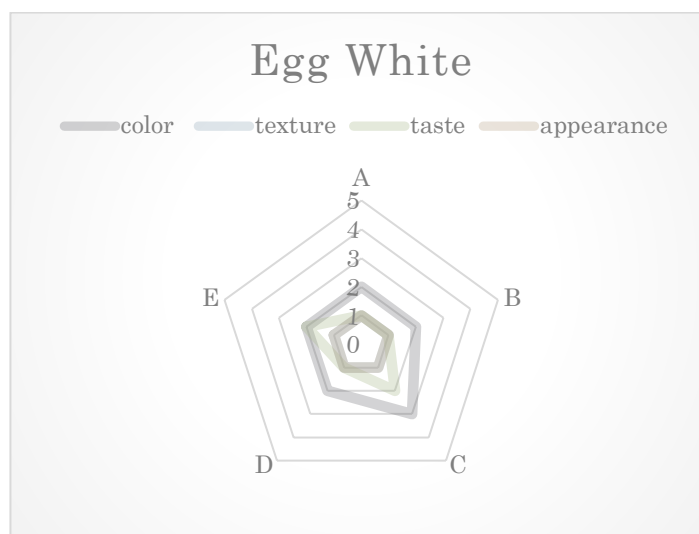
Picture 11. Egg white

Sensory Evaluation

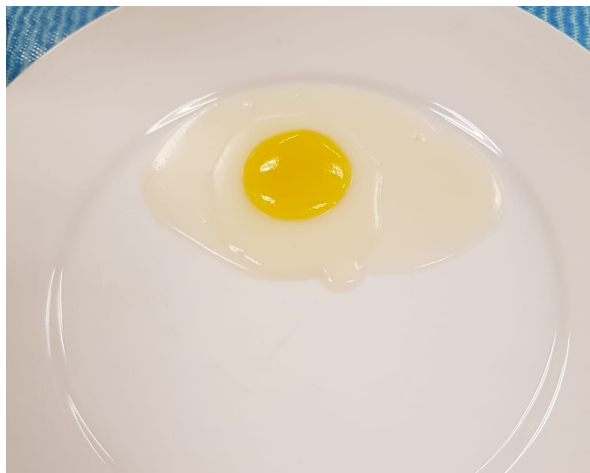
Table 3. Sensory Evaluation Sheet

Evaluator	Color	Texture	Taste	Appearance
A/B/C/D/E				

Radar Plot 3. Sensory evaluation for egg white



Week 3



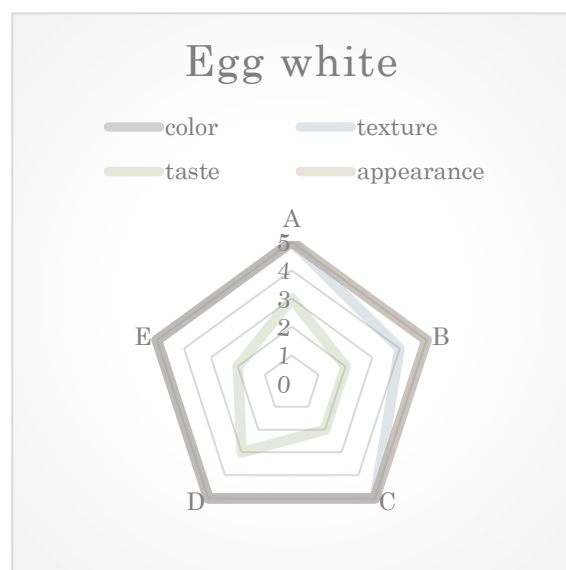
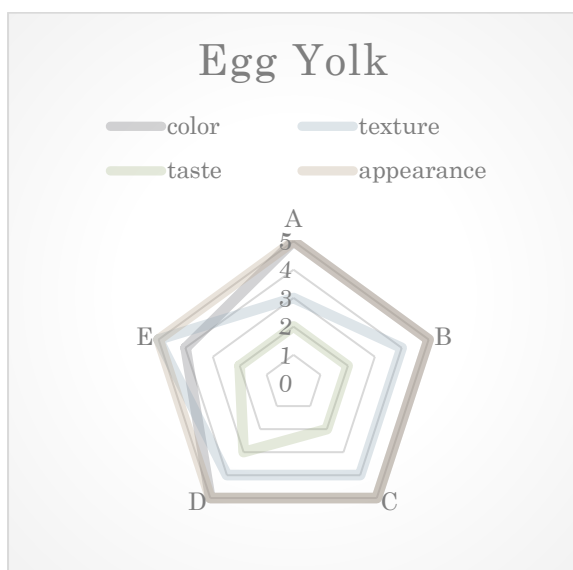
Picture 12. Egg white & Egg yolk

Sensory Evaluation

Table 4. Sensory Evaluation Sheet

Evaluator	Color	Texture	Taste	Appearance
A/B/C/D/E				

Radar Plot4.Sensory evaluation for egg yolk - Radar Plot 5.Sensory evaluation for egg white



Week 4



Picture 13. Beans & Sausage



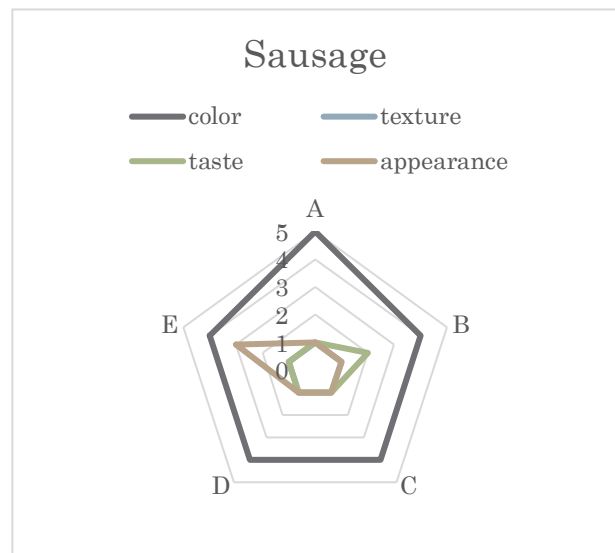
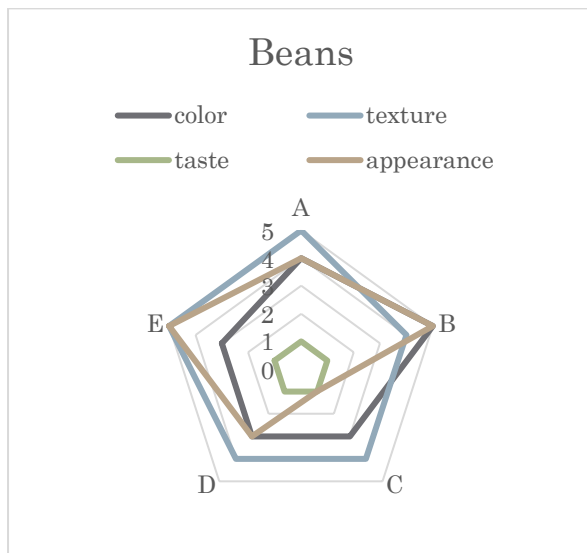
Picture 14. Bloody Mary Cocktail

Sensory Evaluation

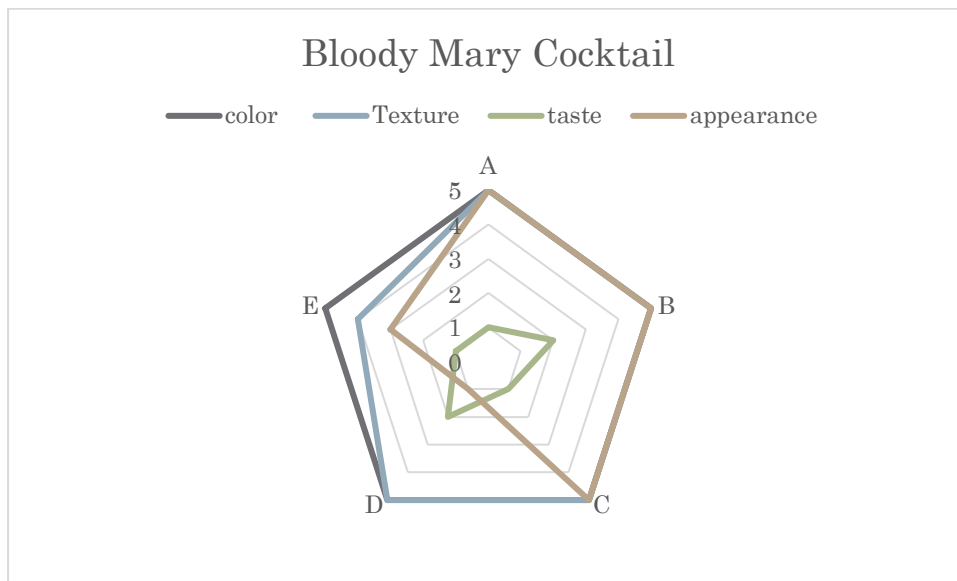
Table 5. Sensory Evaluation Sheet

Evaluator	Color	Texture	Taste	Appearance
A/B/C/D/E				

Radar Plot 6. Sensory evaluation for beans - Radar Plot 7. Sensory evaluation for sausage



Radar Plot 8. Sensory evaluation for Bloody Mary Cocktail



Week 5



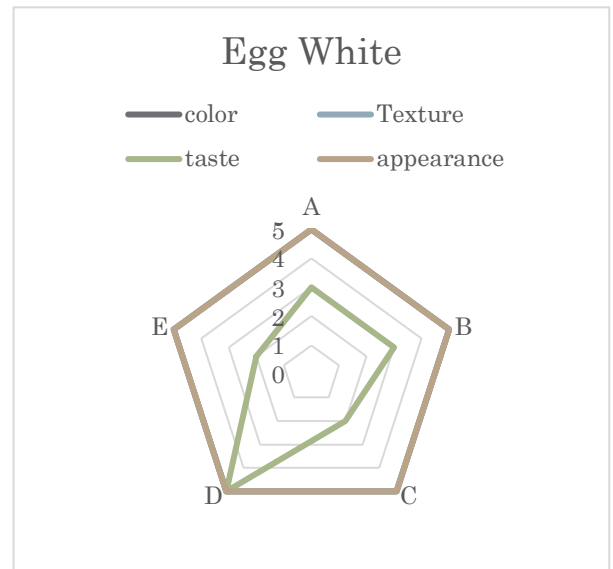
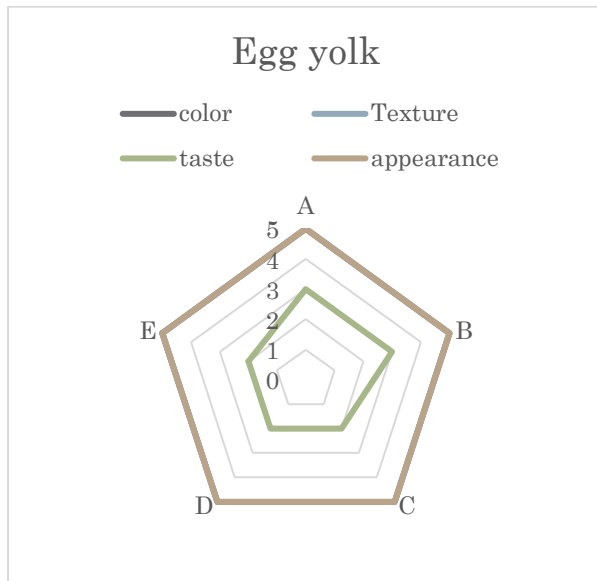
Picture 15. Final Dish: Eggs, Beans, Sausage & Cocktail

Sensory Evaluation

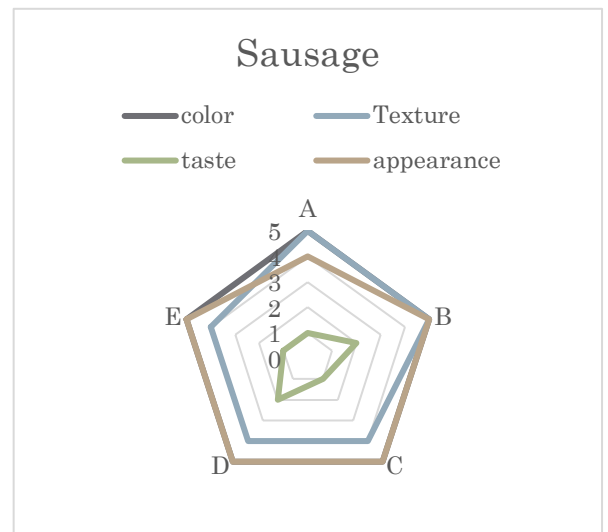
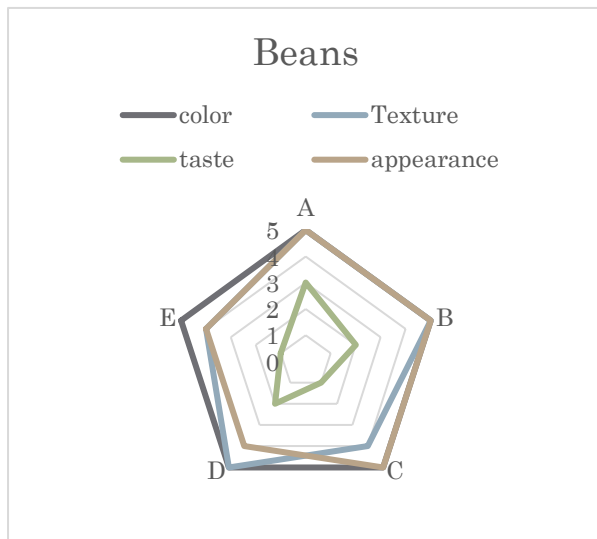
Table 5. Sensory Evaluation Sheet

Evaluator	Color	Texture	Taste	Appearance
A/B/C/D/E				

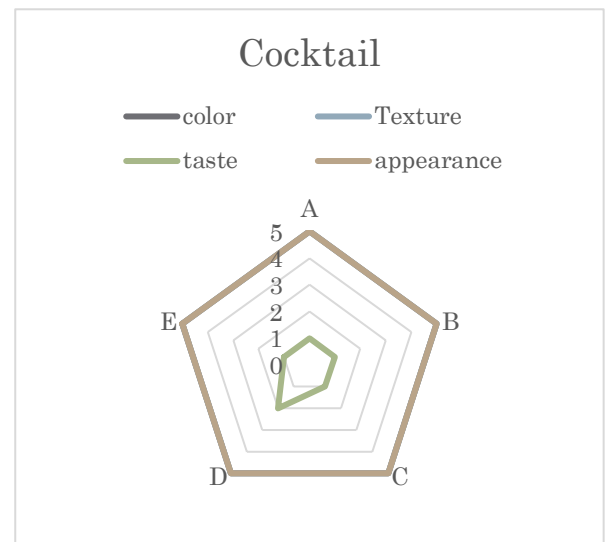
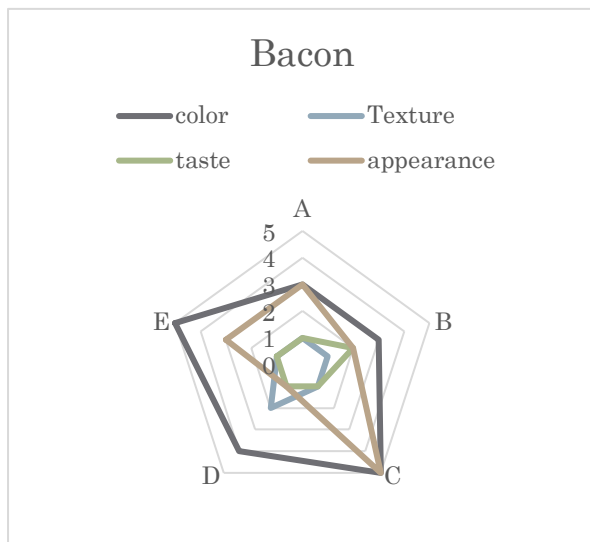
Radar Plot 9.Sensory evaluation for egg yolk - Radar Plot10.Sensory evaluation for egg white



Radar Plot 11.Sensory evaluation for beans - Radar Plot12.Sensory evaluation for sausage



Radar Plot 13.Sensory evaluation for bacon - Radar Plot14.Sensory evaluation for cocktail



5. Discussion

Vegan meat may sound like an antithesis, but it's tending to be the future of the meat. Through the collaboration of chefs and scientists, it's a common phenomenon on plates of million people who do not consume animal products.

At the 2016 Milken Institute Global Conference in Los Angeles, Eric Schmidt, executive director of Alphabet, Google's parent company, listed plant-based proteins as the most important trend in tech, beating out 3D printing, self-driving cars, mobile medical data, virtual reality, and education programs. According to the Good Food Institute, an organization that specializes in supporting the development of plant-based food products, Schmidt predicts we're entering a "revolution of replacing livestock with plant proteins."

Switching from regular meat to plant-based foods would reduce greenhouse gas emissions and climate change on a planet that's getting smaller and packed day after day, meat is more controversial and more problematic than ever before writes GFI's Brian Kateman.

"The two big questions are, how do we feed 9 billion people by 2050, and what can we do about climate change?" asks Good Food Institute executive director Bruce Friedrich. "Plant-based and lab-grown meat products are the answer to both of these questions."

The "Irish Breakfast in the Forest" is a Molecular dish made from compounds. The purpose of making that dish is the consumer to intake exactly the same amount of protein with a typical Irish breakfast, without consuming animal tissue.

According to the sensory evaluation of the final dish, evaluators found the appearance overall very good. The dish has a good texture but the taste has to be reviewed in order to improve it.

The bacon is the least favourite of all as it lacks not only in taste but also in texture. A different type of protein added could be the path to improve the texture, as well as adding a flavouring could definitely improve the taste.

The egg overall was evaluators' favourite, as appearance and texture were highly rated, while the taste needs improvement. That could be achieved adding sugar and a higher amount of flavouring.

Beans found to have a very appealing color, very good texture, overall a good appearance but the taste needs a boost. That could happen trying different types of flavours and increasing the amount of sugar.

Evaluators found the sausage very appealing regarding texture, color and appearance but the taste is the part the product lacks. That could also be improved changing the sugar and flavouring ratio.

The Bloody Mary Cocktail had 5/5 in texture, color & appearance but also lacked in flavour. A possible reason could be the nature of the cocktail as it is foam, so it is difficult to achieve rich flavour in that form.

6. Conclusion

Be it health, diet, environmental or ethical concerns, consumers' appetite for plant-based meat is getting bigger than ever. Increased demand for vegetarian options is something retailers and restaurants have noticed. Meat-replicating feature certainly makes the concept of meat-free foods more newsworthy and intriguing for consumers which, combined with health credentials, ethical claims and environmental considerations, creates a compelling proposition.

Following the "meat free meat" trend, the "Irish Breakfast in the Forest" is a dish that could be consumed from people that follow that diet, giving themselves the chance to eat an animal free product with exactly the same protein intake as the original one.

7. References

Kateman Brian (2016). *Washington Post* article meat “reducetarianism” published online 2016-07-19.

This Herve (2013). Molecular gastronomy is a scientific discipline, and note by note cuisine is the next culinary trend. *Flavour* 2 (1).

This Herve (2012). Solutions are solutions, and gels are almost solutions. *Pure Appl Chem.*, ASAP article. <http://dx.doi.org/10.1351/PAC-CON-12-01-01>, Published online 2012-09-10.

This Herve (2011). Molecular gastronomy in France. *Journal of Culinary Science & Technology* 9(3):140.

This & Myhrvold, *encyclopaedia Britannica* published online 2018-06-22

The Good Food Institute published online 2016-04-18 www.gfi.org/

The guardian published online 2018-11-29 www.theguardian.com

8. Log Book

Week 1

Aim

The aim was to create 1 “egg” mimicking the amount of protein of a real egg.

Objectives

Trying different types of protein and flavourings will create a dish with a jelly texture.

Materials

Whey protein (Bulk Powders), H₂O, sucrose, agar, white color, yellow color, yogurt flavouring, vanilla flavouring, cherry flavouring

Methods

Recipe

Egg white :

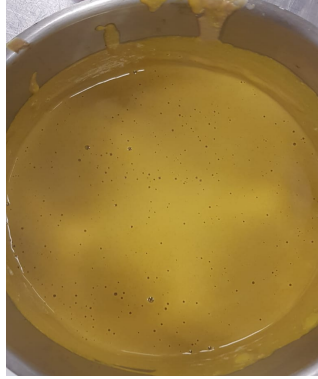
In 300ml of H₂O we add ½ of teaspoon agar, ½ teaspoon white color, 2 drops of yogurt flavour, 1 drop of vanilla flavour & 60 gr of whey protein. We boil the mixture for 3 mins and then we transfer it to a plate in order to cool down.

Sensory Evaluation

Evaluator	color	texture	taste	appearance
A	5	3	2	3
B	2	4	2	3
C	3	1	2	4
D	2	3	1	4
E	3	1	2	3

Egg yolk:

In 261 gr of water we add 39 gr of whey protein, 1 teaspoon sugar, ½ teaspoon agar, ½ teaspoon yellow color & 2 drops of cherry flavour. We boil the mixture for 3 mins and then we transfer it to a plate in order to cool down.



Picture 16. Egg yolk preparation

Sensory Evaluation

Evaluator	color	texture	taste	appearance
A	1	1	1	1
B	2	1	1	1
C	1	2	1	1
D	1	1	1	1
E	1	1	2	3

Results



Picture 17. Egg white & Egg yolk

Recommendations for next week

- Smaller portion
- Change the type of the protein
- Add sugar to the egg white

Week 2

Aim

The aim was to create 1 “egg” mimicking the amount of protein of a real egg.

Objectives

Trying different types of protein and flavourings will create a dish close to the appearance of a real egg.

Materials

Soya protein (Bulk Powders), micellar casein (Bulk powders), H2O, sucrose, agar, white color, yogurt flavouring, vanilla flavouring.

Methods

Recipe

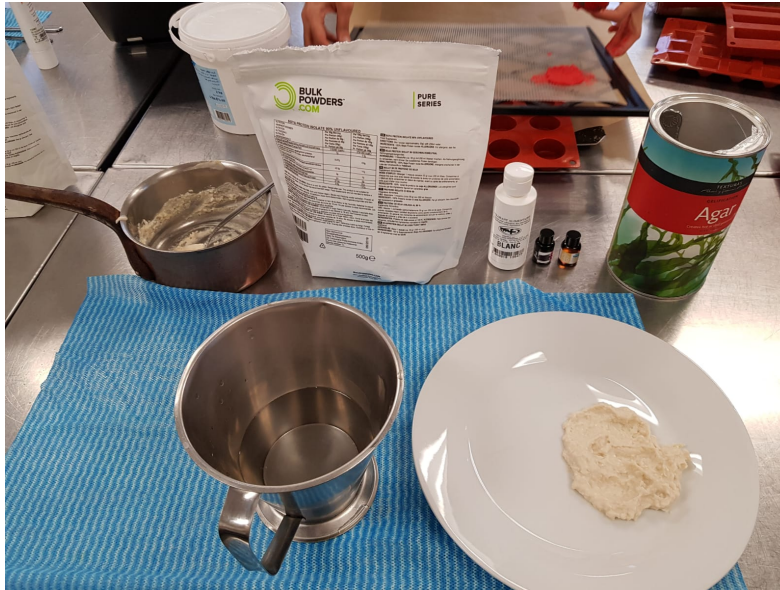
Egg white :

In 89gr of H2O we add ½ of teaspoon agar, ½ teaspoon white color, 2 drops of yogurt flavour, 1 drop of vanilla flavour & 11 gr of soya protein. We boil the mixture for 3 mins and then we transfer it to a plate in order to cool down.

Sensory Evaluation

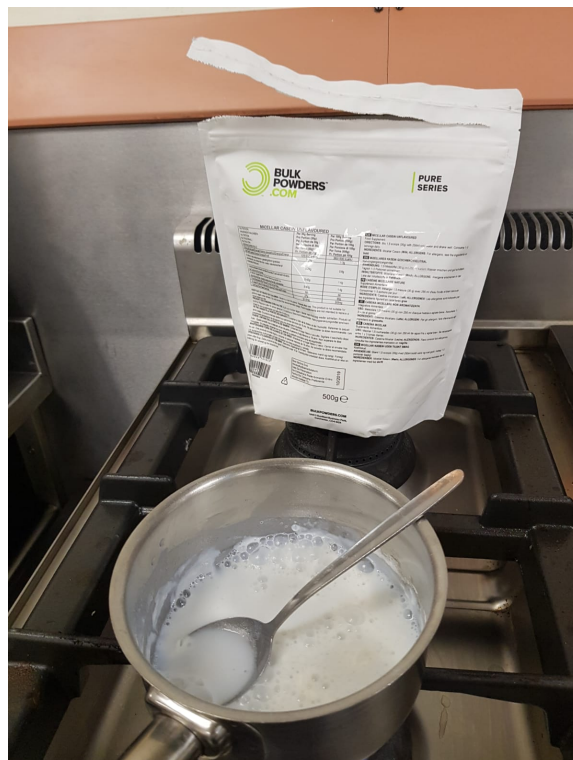
Evaluator	color	texture	taste	appearance
A	2	1	1	1
B	2	1	1	1
C	3	1	2	1
D	2	1	1	1
E	2	1	2	1

Results



Picture 18. Egg white

In 89gr of H₂O we add ½ of teaspoon agar, ½ teaspoon white color, 2 drops of yogurt flavour, 1 drop of vanilla flavour & 11 gr of micellar casein. We boil the mixture for 3 mins and then we transfer it to a plate in order to cool down.



Picture 19. Egg white

Recommendations for next week

- Change the type of the protein

Week 3

Aim

The aim was to create 1 “egg” mimicking the amount of protein of a real egg.

Objectives

Trying different types of protein and flavourings will create a dish close to the appearance of a real egg.

Materials

Hydrolised collagen (MyPotein), H₂O, sucrose, agar, white color, yellow color, yogurt flavouring, vanilla flavouring, spiced apple flavouring.

Methods

Recipe

In 89gr of H₂O we add ½ of teaspoon agar, ½ teaspoon white color, 2 drops of yogurt flavour, 1 drop of vanilla flavour & 11 gr of hydrolysed collagen. We boil the mixture for 3 mins and then we transfer it to a plate in order to cool down.

Results



Picture 20. Preparing the Egg white



Picture 21. Egg white

Sensory Evaluation

Evaluator	color	texture	taste	appearance
A	5	5	3	5
B	5	4	2	5
C	5	5	2	5
D	5	5	3	5
E	5	5	2	5

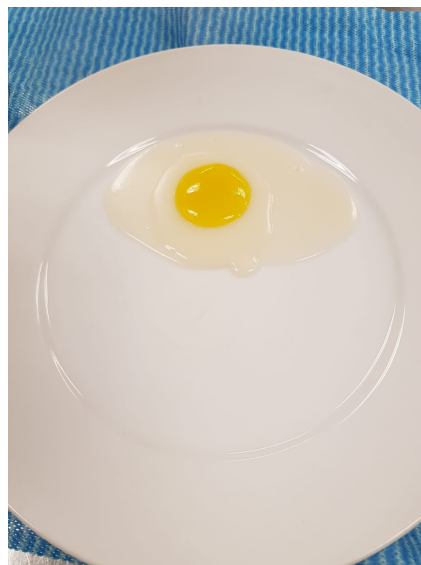
Egg yolk:

In 84gr of water we add 16gr of hydrolysed collagen, 1 teaspoon sugar, ½ teaspoon agar, ½ teaspoon yellow color & 2 drops of cherry flavour. We boil the mixture for 3 mins and then we transfer it to a plate in order to cool down.

Sensory Evaluation

Evaluator	color	texture	taste	appearance
A	5	3	2	5
B	5	4	2	5
C	5	4	2	5
D	5	4	3	5
E	4	5	2	5

Results



Picture 22. Egg white & egg yolk

Recommendations for next week

- Prepare the beans, sausage & Bloody Mary cocktail.

Week 4

Aim

The aim was to create 1 sausage & 1 beans gel cube, as well as the cocktail foam.

Objectives

Trying different types of protein and flavourings will create a dish close in a gel cube form and a foamy Bloody Mary Cocktail.

Materials

Hydrolised collagen (MyPotein), H2O, sucrose, sodium chloride, agar, bronze color, red color, orange flavouring, tomato flavouring, chilli flavouring, vodka flavouring, lemon flavouring & raspberry flavouring..

Methods

Recipe

In 80gr of H2O we add ½ of teaspoon agar, ½ teaspoon red color, 2 drops of raspberry flavouring, 1 teaspoon sucrose & 20 gr of hydrolysed collagen. We boil the mixture for 3 mins and then we transfer it to a silicone mould in order to cool down.

Sensory Evaluation

Evaluator	color	texture	taste	appearance
A	4	5	1	4
B	5	4	1	5
C	3	4	1	1
D	3	4	1	3
E	3	5	1	5



Picture 23. Sausage preparations

Results



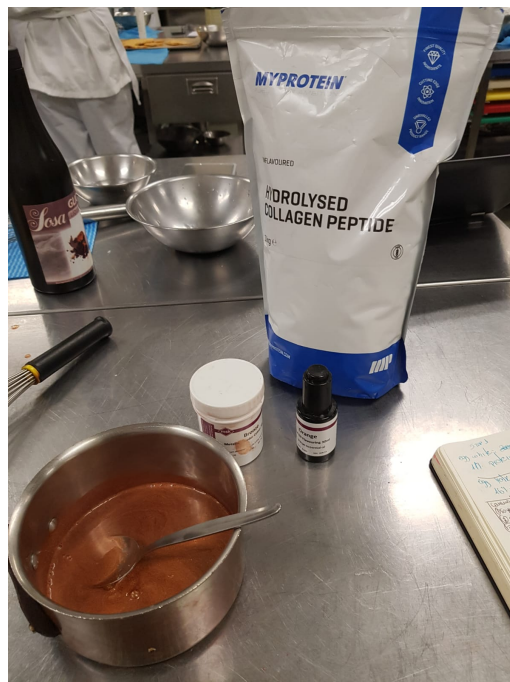
Picture 24. Pork Sausage

Recipe

In 95gr of H₂O we add ½ of teaspoon agar, ½ teaspoon bronze color, 2 drops of orange flavouring, 1 teaspoon sucrose & 5 gr of hydrolysed collagen. We boil the mixture for 3 mins and then we transfer it to a silicone mould in order to cool down.

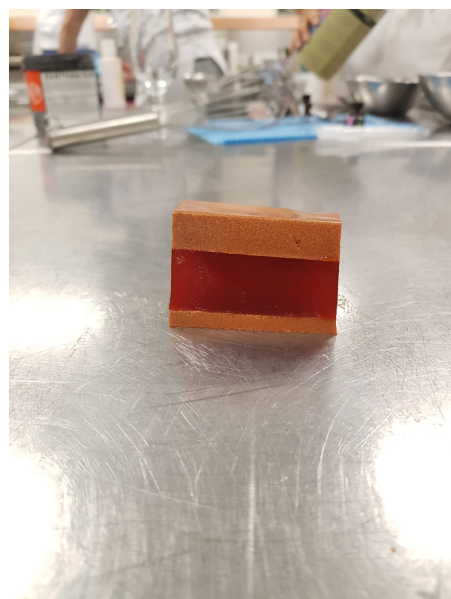
Sensory Evaluation

Evaluator	color	texture	taste	appearance
A	5	1	1	1
B	4	1	2	1
C	4	1	1	1
D	4	1	1	1
E	4	1	1	3



Picture 25. Beans preparation

Results



Picture 26. Beans & Sausage jelly cube

Recipe

In 100gr of H₂O we add ½ of teaspoon salt, 2 drops of tomato flavouring, 2 drops of lemon flavouring, 2 drops of vodka flavouring, 2 drops of chilli flavouring & 1 teaspoon lecithin. We mix the mixture for 3 mins using hand blender creating a red foam.

Sensory Evaluation

Evaluator	color	Texture	taste	appearance
A	5	5	1	5
B	5	5	2	5
C	5	5	1	5
D	5	5	2	1
E	5	4	1	3

Results



Picture 27. Bloody Mary Cocktail

Recommendations for next week

- Chill the jelly cubes for faster results
- Prepare the bacon