Advanced Molecular Gastronomy

TFCS9025

Note-By-Note Dish

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Contents

Introduction

The term and field of study, Molecular Gastronomy, since it's conceptualisation by Nicholas Kurti and Herve This, has come a long way. Starting off with explorations and testing of culinary practices with a scientific basis it has grown and have been applied in numerous areas of food innovation (Burke, This and Kelly, 2016). There have been numerous opposition towards the promotion of molecular gastronomy in kitchens, with famous chefs trying to discredit this field by claiming that "cooking should remain an art" (Spence and Youssef, 2018). But one of the most important thing Molecular gastronomy is doing is that it is trying to bridge the gap between art of food making and the science behind it (Van Der Linden, McClements and Ubbink, 2008).

Food is not supposed to be just the intake of essential nutrients. Food is deeply personal and evokes strong emotions in people. The science of the interplay of visual cues, olfactory cues and sometimes even auditory cues in the acceptance of food is also one of the key areas of study under molecular gastronomy.

In this 10th edition of Note-by-Note cooking, the theme being savoury cubes has given a lot of insights on how the fields of art and craftmanship is involved along with scientific principles and regulations in the development of a perfect dish.

The dish called Vegetable Curry is presented and described below. It is mainly inspired by the complex flavour layering of a traditional spicy Indian dish- mixed vegetable curry. Indian cuisine has traditionally used a plethora of techniques to find extremely unlikely balance of flavours and textures. Dishes like idli sambar pairs fermented rice powder which is boiled with a spicy vegetable and lentil stew sometimes cooked in coconut oil. The tanginess of the fermented rice, the nuttiness imparted by the lentils, the bitterness of the drumstick vegetable topped with the sambar spice (a combination of cumin, coriander, curry leaves) with undertones of coconut flavour. Indian cuisine usually plays with all your five tastes and creates a burst of flavours.

This dish, Vegetable Curry captures only a small portion of this complexity, while using the principles of Note-by-Note cooking.

Aim

The main aim is to create a Vegetable Compounds using only pure compounds

Objectives

- To research the synergies between the pure compounds
- To finalise the compounds to be used
- To attempt recreating the Vegetable Curry using only pure compounds and flavours
- Presentation of dish in visually appealing way

Final Materials and Methods

Materials-

For Gels

- Agar- 1 g
- Inulin- 3 g
- Vegetable Powder
    - Tomato and Carrot- 3 g (each)
- Salt- 1 g
- Water- 100mL
- Flavour- Ripe Tomato for tomato cube

For Sauce

- Casein- 20g
- Water- 10 ml
- Salt- 1 g
- Curry Flavour – 1 drop
- Spearmint Flavour- 1 drop
- Onion Flavour- 1 drop
- Chilli Flavour- 3 drops
- Mallard Ferriere yellow food colouring gel- 1 drop

For Crisp

- Wheat flour- 35g
- Cheese Powder- 5g
- Water- 20 ml
- Salt- 0.2 g
- Chilli flavour- 1 drop
- Oil- for frying- 400ml

Method-

For gel

- Carrot and tomato vegetable powders with inulin is mixed
- The agar, fibre, vegetable powder and salt are first put together in a pan and mixed lightly
- Then water is poured to this mix and stirred thoroughly. The agar was at a 1% strength
- This mix was boiled for 5 minutes.
- Then it was allowed to cool till it set as a gel
- Then it is shaped into cubes

For sauce

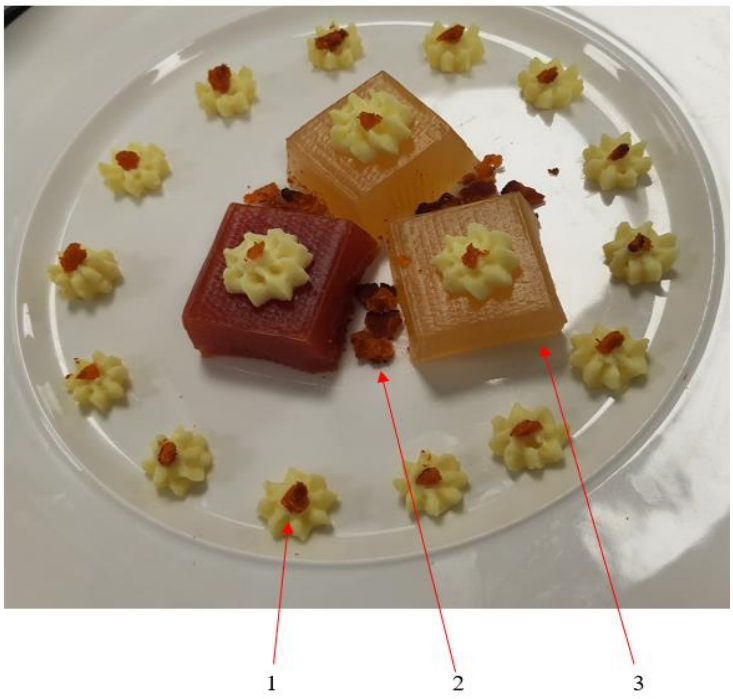
- Casein is measured and set on a bowl
- The salt and flavours are added
- Water is added till it achieves a thick consistency
- One drop of yellow food colouring is added
- This is mixed thoroughly to remove any clumps of casein and ensure a smooth consistency
- Then this sauce is poured into a piping bag

For crisp

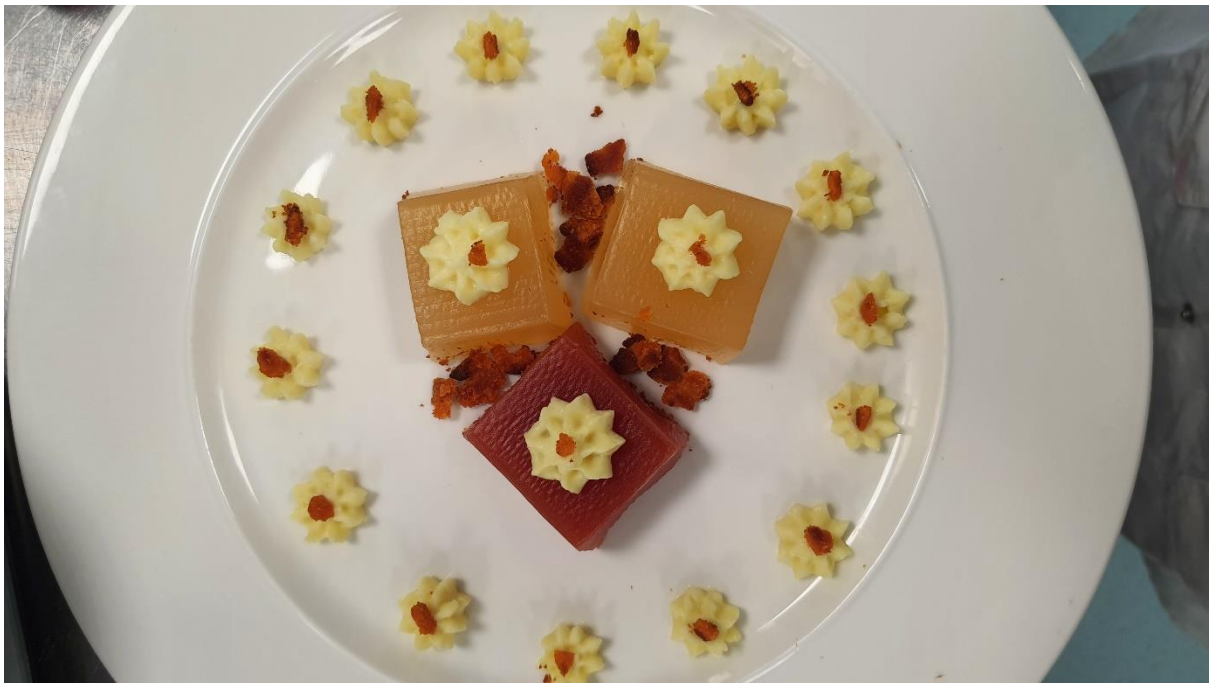
- Oil is heated
- Meanwhile, the flour, cheese powder and salt are added and mixed together
- Then to this mix water is added gently and the mix is kneaded to develop the gluten network
- The kneaded dough is cut into very thin layers
- These thin layers are then deep fried in oil
- After it is fried, crush the layer into small crispy pieces

Results

The layering has been done in the following manner-



1- Casein sauce drops
2- Crispy wheat pieces
3- Carrot/Tomato gel



Taste

The sauce drops have a well-rounded smell with the flavours (mint/ curry/ chilli and onion).

It goes in a balanced manner with the vegetable gel.

Texture

The crisp, sauce and vegetable cube are eaten together. The smooth consistency of the casein drops go well to balance the jelly-like mouthfeel of the vegetable cubes which is also balanced by the crushed crisp providing a grainy texture.

Discussions

Agar and its functionality

Agar is a hydrocolloid derived from marine algae. It is a mixture of the polysaccharides agarose and agaropectin in various proportions (Armisén and Galatas, 2009). Agar gelation happens through hydrogen bonding. It has a gelling temperature of around 38 ˚C and a melting temperature of 85 ˚C. According to EU Regulations, Agar is considered as an additive to food and has a code- E406. Agar forms a tasteless gel and hence it doesn't interfere with the taste of the vegetable powders like tomato and carrot which has been used. The digestibility of agar is very low (almost around 10%) (Armisén and Galatas, 2009).

Inulin and its functionality

Inulin is a heterogenous blend of fructose polymers which is widely found in plants. They are found as plant storage carbohydrates across various plants. By using a hot water diffusion process, inulin is extracted from roots (like chicory) (Niness, 1999). Inulin are of relatively low viscosity and are usually a clear solution (Shoaib *et al.*, 2016). Chemically, inulin is a polymer of fructose with a β-(2-1)-d-frutosyl fructose bonds which makes it indigestible in the small intestines of humans. Inulin has been widely used in the food industry as a fat replacer, a sugar replacer, as a prebiotic and as a fibre enrichment (Shoaib *et al.*, 2016). The taste of inulin can be sweet as these oligo-fructoses can provide up to 30-50% of sweetness table sugar (Kaur and Gupta, 2002). Hence, incorporation of inulin will introduce a little bit of sweetness. This slight sweetness of inulin is in synergy with the slightly acidic flavour of tomato powder. Hence, inulin is acting as the fibre content as well as a mild sweetener.

Casein and its functionality

Casein is a protein derived from milk. It is composed of several protein fractions like the alpha casein, beta casein and kappa casein which are usually held together by calcium phosphate complexes (Fox and Mulvihill, 1990). The micellar casein is different from the other forms of casein because the micellar form is maintained in this product (Hammam, Martínez-Monteagudo and Metzger, 2021). The following table gives us the unique properties imparted by micellar casein-

Functional properties	Casein (CN)
Hydration	High water binding capacity at higher concentration gels Minimum at the isoelectric point (pH = 4.6)
Solubility	Insoluble at the isoelectric point (pH = 4.6)
Viscosity	Low viscosity at the isoelectric point (pH = 4.6) A viscous solution at neutral and alkaline pH
Gelation	Micelle gelation by rennet enzyme No thermal gelation except in the presence of calcium
Emulsifying properties	Excellent emulsifying properties at neutral and alkaline pH
Foaming properties	Good foaming properties and overrun but low foam stability
Flavor binding	Good flavor binding

Functional properties of Micellar Casein [Adapted from (Lorient, Closs and Courthaudon, 1991)]

We can see that micellar casein has a very good flavour binding capacity. This might be one of the reasons why the flavours added (spearmint, onion, chilli and curry) had a good prominence in the sauce. In taste, micellar casein has a bland flavour. Hence the addition of chilli and salt will provide the prominent flavour.

Flavours synergy

The five basic tastes- salty, sweet, sour, bitter and umami- can give rise to numerous flavour combinations. Add to this mix, the texture, temperature and mouthfeel and it gives rise to an immense possibility of combinations (Marcus, 2013).

In the Vegetable Curry dish, the flavours had been selected based on classical pairings of flavours to recreate both the feel of the vegetable as well as the dish as a whole.

The curry and onion flavour in the sauce had been selected because in traditional preparation of this dish, onions are sautéed first to bring out the onion flavour in the oil. Then along with the onions, the curry spices are added. This mix is further sauteed to bring out the flavour compounds from the curry spice. The crisps have cheese powder in them and this pairs well with the freshness of the carrot gel which is also a bit salty. The tomato gel has a synergy between the sweetness of inulin, slight acidity of the tomato powder and slight saltiness.

Traditionally, towards the end of the cooking, garnishing like mint or coriander is introduced. This is done to balance the flavours. The freshness of the mint brings out the delicate flavour of tomato and the carrot. Hence the curry drops have also been loaded with mint flavour.

Overall, according to the sensory analysis done by my colleagues, there is a good synergy of flavours and taste.

Presentation

According to feedback received during the trial period, it was suggested that the plate should not be full of vegetable cubes topped with a sauce with thin texture. Hence, the number of cubes were reduced to three and the sauce got a base of micellar casein. This gave the sauce a thicker body which is paired well with the jelly texture of the vegetable cube. The sauce also has a yellow colour added to it to give it the colour of curry. The curry drops are arranged across the outer circumference of the plate and the vegetable cubes are at the center. This placement makes it easy to cut the vegetable cube and dab it in a bit of curry sauce. The crisps are placed right alongside the cubes so that it is easier to scoop it up along with the vegetable cube.

Conclusion

According to sensory analysis performed, the overall acceptability of the Vegetable Curry dish had moderate acceptance. The curry sauce had an overall higher acceptance in terms of a sauce (7 out of a 10 scale). In comparison, the vegetable cubes were not high in acceptability (5 out of a 10 scale). This was probably because the agar used, could not capture the complex texture of vegetables. One another factor for a lower acceptability of the dish was that, traditionally curry dishes have been consumed when they are hot. So, the ambient temperature at which the dish was served did not relate well with images evoked when the name curry comes up.

Appendices

Log Books

WEEK NO: 1 **DATE: 28th March**

Weekly Aims and Objectives

- Test out setting of agar with fibres, salt and vegetable powder

Materials and Method (Ingredients, Equipment and Method)

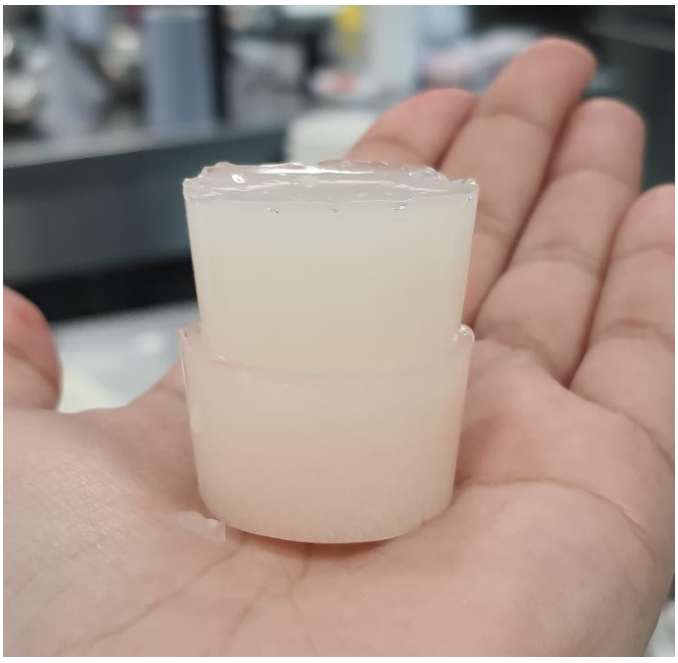
Materials-

- Agar- 2 g
- Fibres
    - Cellulose, Inulin- 3 g (each)
- Vegetable Powder
    - Tomato, Beet, Carrot- 3 g (each)
- Salt- 1 g
- Water- 100mL

Method-

- Different combinations of the gel were made in the following order-
    - A batch of all three vegetable powders with cellulose
    - A batch of all three vegetable powders with inulin
- The agar, fibre, vegetable powder and salt are first put together in a pan and mixed lightly
- Then water is poured to this mix and stirred thoroughly. The agar was at a 2% strength
- This mix was boiled for 5 minutes.
- Then it was allowed to cool till it set as a gel

Results and discussion



The gels with cellulose fibre in them was harder to set. They had a grainy and cloudy appearance

The gels with inulin fibre were firmer and clearer. This was because inulin has a higher solubility in water than other fibres

2% agar gel is a bit too firm. I planned to go ahead with 2% thinking that presence of fibre and vegetable powder will affect the setting

Some comments

There was a very little perception of aroma in beet and carrot. Hence this needs to be modified with addition of various flavours

Conclusions

I plan to go ahead with both the fibres and try to layer them into different shapes

I plan to decrease the percentage of agar

Recommendations for following week

Test out the combination of shapes and flavour

WEEK NO: 2 **DATE: 1st April**

Weekly Aims and Objectives

- Test out shapes and combinations of the gel
- Enhance flavour

Materials and Method (Ingredients, Equipment and Method)

Materials-

- Agar- 1 g
- Fibres
    - Cellulose, Inulin- 3 g (each)
- Vegetable Powder
    - Tomato, Beet, Carrot- 3 g (each)
- Salt- 1 g
- Water- 100mL
- Flavours
- Green colour

Method-

- 3g of beet vegetable powder was taken and 3 g inulin was mixed with1 g agar
- 3 g of carrot vegetable powder was taken and 3 g cellulose was mixed with1 g agar
- Inulin was added to 1 g agar and two drops of green colouring was added
- Then water is poured to these separate mixes and stirred thoroughly. The agar was at a 1% strength

- These mixes were boiled for 5 minutes. During this step, drops of flavours were added
- To the carrot mix, vegetable flavour was added
- To the beet mix, Celery and vegetable flavour was added
- The layering was done as follows

Results and discussion

Layer 1: Carrot and cellulose

Layer 2: On top of carrot layer, beet and inulin gels were set

Layer 3: Then to this, the green inulin mix was poured and allowed to set. So it looked like-

The cellulose gel was not very firm with just 1% agar. Proper shape could not be formed

There was a very bitter taste coming from one of the combinations

Some comments

After comment from Professor Pauline, trials without celery flavour were carried out and hence it was concluded to drop this flavour

Conclusions

Celery flavour is dropped

Cellulose with 1% agar is dropped

The layering idea of gels is also dropped

Recommendations for following week

I plan to make cubes of different colour without using artificial colour and arrange them according to colour

WEEK NO: 3 **DATE: 4th April**

Weekly Aims and Objectives

- Different colours of cubes and their arrangement

Materials and Method (Ingredients, Equipment and Method)

Materials-

- Agar- 1 g
- Fibres
    - Inulin- 3 g (each)
- Vegetable Powder
    - Tomato, Beet, Carrot- 3 g (each)
- Salt- 1 g
- Water- 100mL

Method-

- A batch of all three vegetable powders with inulin were made

- The agar, fibre, vegetable powder and salt are first put together in a pan and mixed lightly
- Then water is poured to this mix and stirred thoroughly. The agar was at a 1% strength
- This mix was boiled for 5 minutes.
- Green tomato flavour was added to tomato mix
- Then it was allowed to cool till it set as a gel
- After the gel sets, it is cut in small cubes and arranged

Results and discussion

It was planned that a curry flavoured sauce will be made and poured on top of this so that it can resemble a mixed vegetable curry dish.

BUT

The following feedback was received-

- The plate shouldn't contain more than four vegetable gels.
- The sauce can be introduced as minimalistic dots
- There should be something crispy to pair with the gels and sauce

Conclusions

To pair the vegetable gels, I plan to make curry flavoured sauce and a cheese flavoured spicy crisp with flour

Recommendations for following week

Make the final dish

WEEK NO: 4 **DATE: 25th April**

Weekly Aims and Objectives

- **Attempt for final pairing**

Materials and Method (Ingredients, Equipment and Method)

Materials-

For Gels

- Agar- 1 g
- Inulin- 3 g
- Vegetable Powder
    - Tomato and Carrot- 3 g (each)
- Salt- 1 g

- Water- 100mL
- Flavour- Ripe Tomato for tomato cube

For Sauce

- Casein- 20g
- Water- 10 ml
- Salt- 1 g
- Curry Flavour – 1 drop
- Spearmint Flavour- 1 drop
- Onion Flavour- 1 drop
- Chilli Flavour- 3 drops
- Yellow food colouring

For Crisp

- Wheat flour- 35g
- Cheese Powder- 5g
- Water- 20 ml
- Salt- 0.2 g
- Chilli flavour- 1 drop
- Oil- for frying- 400ml

Method-

For gel

- Carrot and tomato vegetable powders with inulin is mixed
- The agar, fibre, vegetable powder and salt are first put together in a pan and mixed lightly
- Then water is poured to this mix and stirred thoroughly. The agar was at a 1% strength
- This mix was boiled for 5 minutes.
- Then it was allowed to cool till it set as a gel
- Then it is shaped into cubes

For sauce

- Casein is measured and set on a bowl
- The salt and flavours are added
- Water is added till it achieves a thick consistency
- One drop of yellow food colouring is added
- This is mixed thoroughly to remove any clumps of casein and ensure a smooth consistency

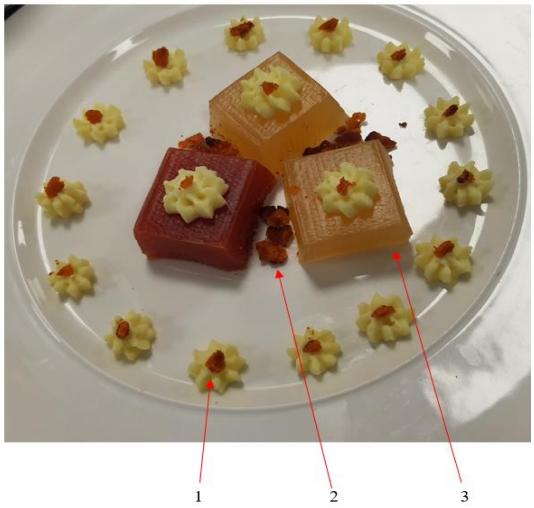
- Then this sauce is poured into a piping bag

For crisp

- Oil is heated
- Meanwhile, the flour, cheese powder and salt are added and mixed together
- Then to this mix water is added gently and the mix is kneaded to develop the gluten network
- The kneaded dough is cut into very thin layers
- These thin layers are then deep fried in oil
- After it is fried, crush the layer into small crispy pieces

Results and discussion

The layering has been done in the following manner-



1- Casein sauce drops
2- Crispy wheat pieces
3- Carrot/Tomato gel

Taste

The sauce drops have a well-rounded smell with the flavours (mint/ curry/ chilli and onion).

It goes in a balanced manner with the vegetable gel.

Texture

The crisp, sauce and vegetable gel are eaten together. The smooth consistency of the casein drops go well

Conclusions

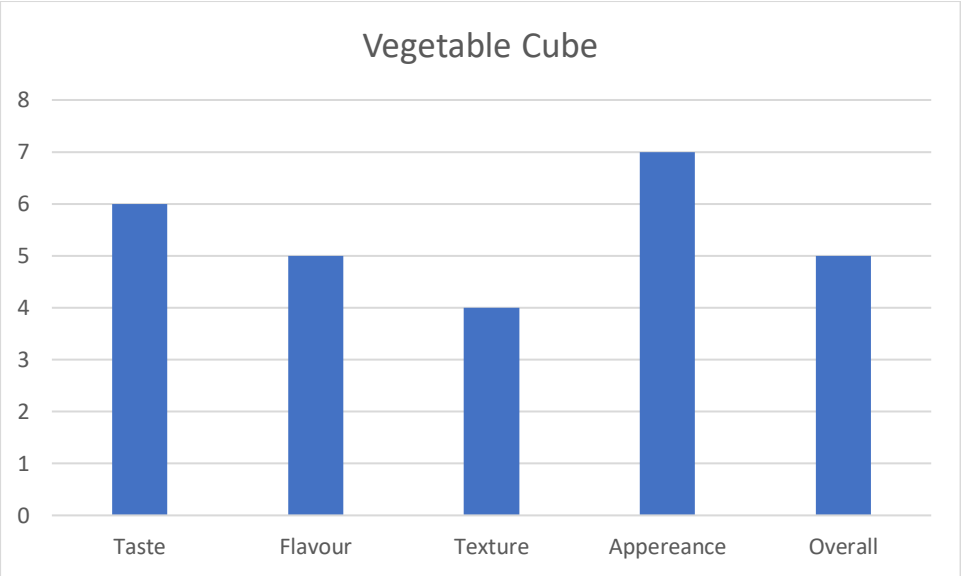
According to general taste preference of colleagues, the flavours are in good synergy. The texture of the crisp can be improved. The gels have good vegetable flavour but texture is not similar to vegetables.

Overall, since mixed vegetable curry is usually served hot, a cold served version of the dish will have negative impacts on the acceptance

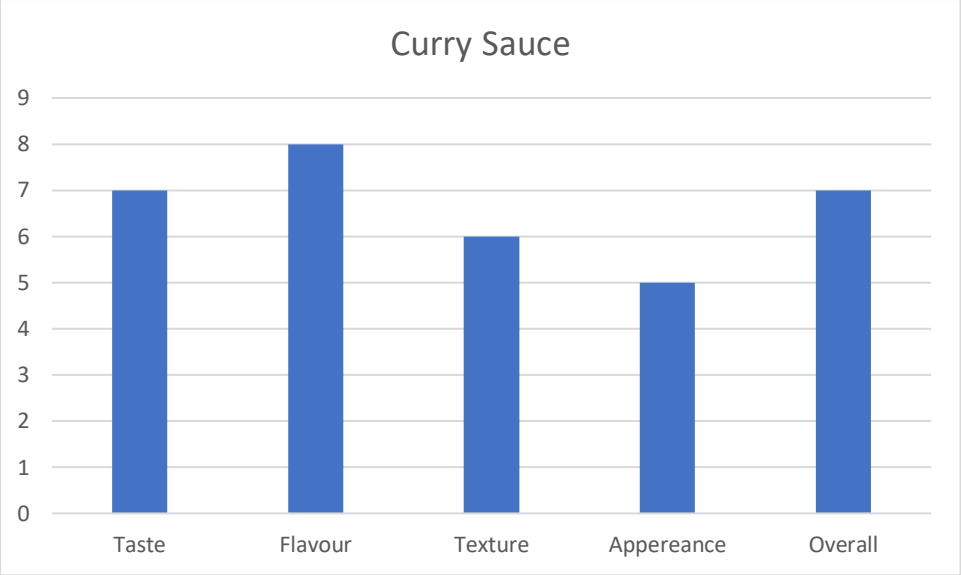
My colleagues were asked to rate the following attributes for the vegetable cubes and curry sauce on a scale of 1-10 with 1 corresponding to “Dislike very much” and 10 corresponding to “Like very much”

Taste, Flavour, Texture, Appearance, Overall acceptability

The overall acceptability of vegetable cubes was 5 and that of the curry sauce was 7.



Sensory analysis result for vegetable cube



Sensory analysis result for curry sauce

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