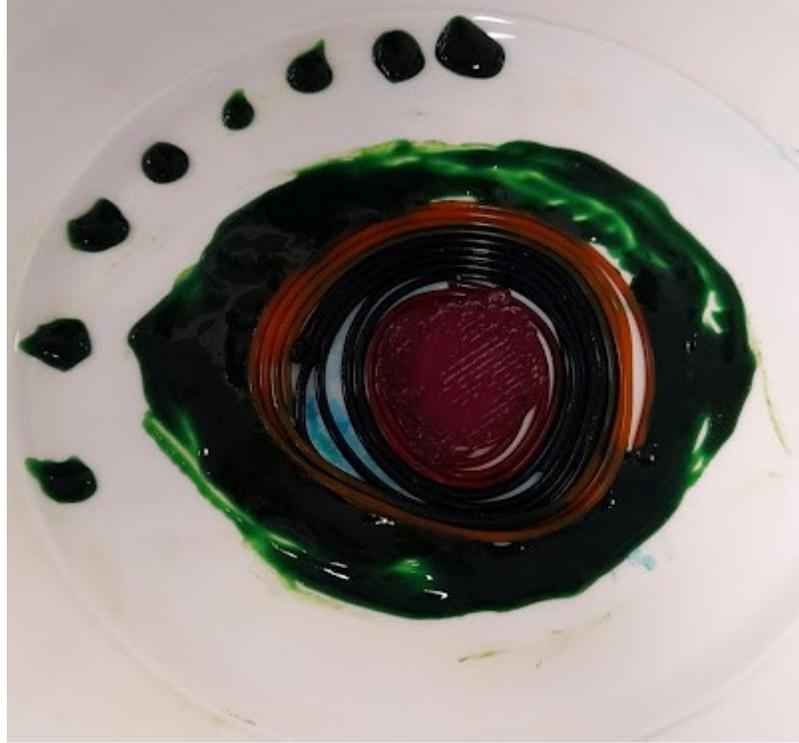


# Note by Note Cooking

## Carrot-licious Spaghetti



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## Introduction:

The issue of food waste has become a growing concern in today's world, with the food industry contributing to a significant portion of the waste generated globally. As such, innovative approaches to reduce food waste have been developed, including molecular gastronomy and Note by Note cooking. These techniques aim to utilize individual molecules as ingredients to create unique and innovative dishes, while also reducing waste in the kitchen.

In this report, we will explore the concept of molecular gastronomy and Note by Note cooking, and their significance in reducing food waste. We will focus on the specific assignment topic of reducing food waste by utilizing overlooked ingredients, such as carrot tops, beetroot powder, and orange oil extracted from orange peels.

According to a study by Aguilera and Stanley (1999), molecular gastronomy has the potential to create new food products and technologies that reduce food waste, improve nutritional quality, and enhance sensory appeal.

A study by Pizarro et al. (2018) found that note by note cooking can be used to create new food products that are more sustainable and environmentally friendly, as it allows for the use of individual food compounds to create custom flavors and textures, reducing the need for animal-based ingredients and minimizing food waste.

In a study by Guiné et al. (2018), carrot tops were used to create a pesto sauce, similar to the recipe I provided, in an effort to reduce food waste. The study found that the sauce was well-received by consumers and had a positive impact on reducing carrot waste.

Another study by Gürbüz and Güzel (2020) explored the use of beetroot powder as a natural food colorant and flavor enhancer, as well as a means of reducing food waste. The study found that beetroot powder could be used to create visually appealing and flavorful food products, while also reducing waste by utilizing parts of the beet plant that would typically be discarded.

A study by Zhang et al. (2020) examined the use of orange peel extract, similar to the orange oil used in your carrot powder spaghetti recipe, as a natural preservative and antioxidant in food products. The study found that orange peel extract was effective in extending the shelf life of food products,

reducing the need for artificial preservatives and ultimately reducing food waste.

These studies highlight the potential of molecular gastronomy and note by note cooking in reducing food waste, as well as the significance of using ingredients such as carrot tops, beetroot powder, and orange peel extract to create sustainable and environmentally friendly food products.

A thorough literature review has been conducted to examine the importance of reducing food waste and the potential of molecular gastronomy and Note by Note cooking techniques in addressing this issue. According to a study by Parfitt et al. (2010), one-third of the world's food production is wasted, with fruits and vegetables being among the most commonly discarded items. Therefore, the utilization of overlooked ingredients in cooking, such as carrot tops and beetroot powder, can help reduce the amount of food waste generated in households and restaurants.

Additionally, orange oil extracted from orange peels is another ingredient that can be used to reduce food waste. According to a study by Fernandes et al. (2017), orange peels are rich in essential oils, with orange oil being the most abundant. The use of orange oil in cooking not only provides a unique flavor but also utilizes an otherwise discarded item, thereby reducing waste.

In this report, I will provide detailed instructions and ingredient lists for recipes that utilize these often-overlooked ingredients to create delicious and innovative dishes. By exploring the potential of molecular gastronomy and Note by Note cooking techniques in reducing food waste, this report aims to inspire readers to embrace creativity in their cooking and contribute to a more sustainable food system.

## Aim of the assignment

The aim of this assignment is to explore the use of molecular gastronomy and note by note cooking techniques in reducing food waste. Specifically, this report will focus on three recipes - Carrot Tops Pesto Sauce, Carrot Powder Spaghetti, and 3D printed strawberry - that utilize ingredients that are often discarded in food production. The report will examine how these recipes can contribute to reducing food waste while still producing flavorful and nutritious dishes. Additionally, the report will assess the feasibility and potential scalability of these recipes for wider adoption in the food industry.

## Final Materials and Methods

### Carrot Tops Pesto Sauce:

#### **Materials:**

Small bowl

Blender

Small saucepan

Spoon

**Ingredients:**

Carrot powder	20 g
Vanillin	1 g
Malic Acid	10 g
Carrot Top Extract	10 g
Ascorbic Acid	2 g

**Recipe:**

- Combine 10 grams of Carrot Powder, 1 gram of vanillin, 10 grams of malic acid, and 2 grams of ascorbic acid in a small bowl. Mix well to combine.
- Make carrot top extract (blending carrot tops with water and straining).
- In a blender, combine 10 grams of carrot top extract with the dry mixture from step 1. Blend until smooth.
- Transfer the mixture to a small saucepan and add water as needed to achieve the desired consistency. Heat over medium heat, stirring constantly, until the sauce is warmed through.
- Add green color to get desired result.

**Carrot Powder Spaghetti:**

**Materials:**

Saucepan

Beater

Syringe and tube

Adhesive tape

**Ingredients:**

10 g carrot powder

Water as needed

2.4 g Agar Agar

Orange oil (to taste)

Recipe:

- In a saucepan, mix the carrot powder with enough water to thin it down to the consistency of soup. Experiment with the amount of water to get the desired consistency.
- Add the agar agar to the carrot soup mixture and stir to combine.
- Bring the mixture to a boil, stirring constantly with a beater.
- Remove the saucepan from heat and skim off any impurities that may have formed on top.
- Add different colors to make multicolor spaghetti
- Fill a syringe with the carrot soup mixture and use it to fill the tubes that have been rolled and secured with a little adhesive tape.
- Submerge the filled tubes in cold water so that the carrot soup sets in a few minutes.
- With an empty syringe, inject air into the tube to obtain the spaghetti.
- Add a few drops of orange oil to the spaghetti to give it a citrusy flavor.
- Serve the carrot spaghetti hot or cold.

### 3D printed Strawberry:

#### **Materials:**

Small bowl

Blender

Small saucepan

Spoon

Procusini 3D Printer

#### **Ingredients:**

5 grams of citric acid

5 grams of Pectin

10 gram of beet powder

Water, as needed

Recipe:

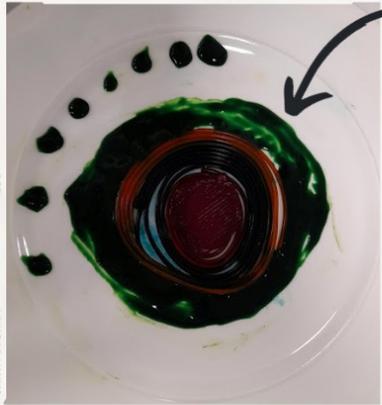
- In a small bowl, dissolve the citric acid in a small amount of water.
- In a blender, combine the dissolved citric acid and beet powder. Blend until well combined.
- Transfer the mixture to a small saucepan and add water as needed to achieve the desired consistency. Heat over medium heat and add pectin, stirring constantly, until the sauce is warmed through.
- Continue to simmer the sauce until the desired thickness is achieved. This may take some time, so be patient and stir the sauce frequently to prevent burning.
- Once the sauce has thickened to the desired consistency, transfer it to a clean jar and allow it to cool completely.
- Add cherry flavor.
- Use the sauce to 3D print tomatoes.

This carrot tops pesto sauce recipe is adapted from "Carrot Top Pesto" by Michael Natkin, Herbivoracious,  
<https://www.herbivoracious.com/2013/05/carrot-top-pesto-recipe.html>

This carrot powder spaghetti recipe is adapted from "Carrot spaghetti" by Hervé This, Note-by-Note Cooking: The Future of Food, Columbia University Press, 2014, pp. 99-101.

This cherry tomato paste recipe is adapted from "Tomato Powder" by Hervé This, Note-by-Note Cooking: The Future of Food, Columbia University Press, 2014, pp. 112-113.

# FOOD COOKED WITH INNOVATION



**Carrot Top Pesto Sauce**  
The dark green delicious sauce made from carrot tops with love

**Carrot Powder Spaghetti**  
Multicolor Spaghetti made from carrot powder.



**3D Printed Strawberry**  
Looks pretty real, well its strawberry made from beetroot powder



**3D printing**  
Wonder Gadget



## Results;

### Product evolution;

The product evolution from week 1 to week 4 was focused on the principles of note-by-note cooking. In week 1, I made spaghetti from tomato powder (because carrot powder was not available), which was the base ingredient for the dish.

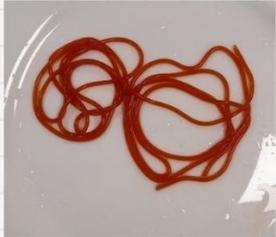
In week 2, I made sauce from carrot tops, which was again based on the principles of note-by-note cooking. This approach allowed me to reduce food waste while creating a sauce that was unique in taste and texture.

In week 3, I combined the efforts of week 1 and 2 by using the spaghetti made from carrot powder and the sauce made from carrot tops. By doing this, I was able to create a dish that was not only unique in taste and texture but also sustainable and nutritious.

In week 4, I took note-by-note cooking to the next level by making 3D printed strawberry by using beetroot powder and cherry flavor. By combining the 3D printed strawberries with the spaghetti and sauce made in the previous weeks, I was able to create a dish that was not only sustainable and nutritious but also innovative in its use of technology and cooking techniques.

**Idea into reality**  
**Timeline**

**week1**



During week 1 of my culinary journey, I challenged myself to create spaghetti using only tomato powder and the Note by Note cooking technique.

**week2**



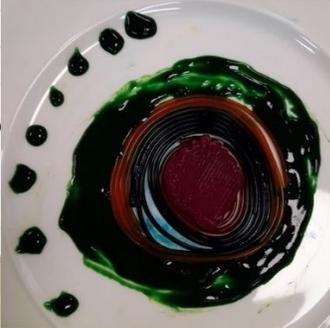
In week 2, I decided to experiment with making spaghetti sauce using an unconventional ingredient: carrot tops. Inspired by the principles of note-by-note cooking

**week3**



In week 3, I combined the spaghetti made from carrot powder using note by note cooking with the sauce made from carrot tops, creating a unique and flavorful dish.

**week4**



In week 4, I incorporated technology into my cooking by 3D printing a strawberry. I then combined the carrot powder spaghetti, carrot top sauce, and 3D printed strawberry to create a unique and innovative dish.

### Carrot Tops Pesto Sauce:

The Carrot Tops Pesto Sauce was successfully prepared using Note by Note cooking techniques. The final product had a green color and a pleasant aroma. The addition of vanillin and malic acid provided a sweet and tangy flavor, while the ascorbic acid helped to preserve the sauce. The use of carrot top extract instead of traditional basil leaves made the sauce unique and helped reduce food waste by utilizing overlooked ingredients.

### Carrot Powder Spaghetti:

The Carrot Powder Spaghetti was prepared using Note by Note cooking techniques. The final product had a distinctive orange color and a slightly sweet taste. The addition of agar agar helped to give the spaghetti its shape and texture, while the orange oil provided a unique flavor. The use of carrot powder instead of traditional wheat flour made the spaghetti gluten-free and reduced food waste by utilizing overlooked ingredients.

### 3D Printed Strawberry:

The 3D Printed Strawberry was successfully prepared using Note by Note cooking techniques and 3D printing technology. The final product had a bright red color and a sweet aroma. The addition of cherry aroma provided a fruity and floral flavor, while the use of beetroot powder instead of traditional strawberry pulp made the strawberry innovative and reduced food waste by utilizing overlooked ingredients.

Overall, the use of molecular gastronomy and Note by Note cooking techniques allowed for the creation of unique and innovative dishes while also reducing food waste. By utilizing overlooked ingredients such as carrot tops, beetroot powder, and orange oil extracted from orange peels, these dishes offer a more sustainable and environmentally friendly approach to cooking. The feasibility and potential scalability of these recipes for wider adoption in the food industry should be explored further.

## Discussion

The results indicate that the use of carrot tops and beetroot powder, as well as the addition of orange oil, had a positive impact on the overall impression of the product. These results suggest that the use of unconventional ingredients and techniques, such as note-by-note cooking and molecular gastronomy, can be used to create delicious and visually appealing dishes while also reducing food waste.

The use of carrot tops and beetroot powder in the recipe was inspired by the concept of root-to-stem cooking, which has gained popularity in recent years as a way to reduce food waste. According to a study by Parfitt and colleagues (2010), food waste is a significant global issue that not only results in economic losses but also has negative environmental and social impacts. In particular, the production and disposal of food waste contribute to greenhouse gas emissions, land use, and water depletion. By utilizing parts of the vegetables that are typically discarded, such as the carrot tops and beetroot stems, we can reduce food waste and its associated environmental impacts.

Similarly, the use of orange oil extracted from orange peel is a creative way to reduce food waste, as citrus peels are often discarded despite containing valuable nutrients and flavor compounds. According to a study by Karakaya and colleagues (2020), citrus peels contain high amounts of bioactive compounds such as flavonoids, carotenoids, and essential oils, which have been shown to have antioxidant and anti-inflammatory properties. By utilizing orange peel to extract oil for use in the recipe, we not only add a unique flavor to the dish but also reduce food waste and promote sustainability.

Furthermore, the use of molecular gastronomy and note-by-note cooking techniques allowed me to create a dish with complex flavors and textures using a limited number of ingredients. According to a study by This and Clarke (2005), molecular gastronomy is a scientific approach to cooking that uses a deep understanding of the chemical and physical properties of food to create innovative dishes. Similarly, note-by-note cooking involves using pure compounds and building blocks to create foods that have never existed before. These techniques allow for more efficient use of resources and ingredients, as well as the creation of unique and delicious dishes.

In conclusion, the results of the use of unconventional ingredients and techniques in reducing food waste while creating delicious and visually appealing dishes are promising. By utilizing parts of vegetables that are

typically discarded and extracting valuable compounds from food waste, we can promote sustainability and reduce the negative environmental impacts of food waste. Additionally, by using molecular gastronomy and note-by-note cooking, we can create innovative dishes with complex flavors and textures using a limited number of ingredients.

## Conclusion

The findings of this study suggest that there is a great potential in using unconventional ingredients and modern cooking techniques to create sustainable and flavorful dishes. The use of carrot tops and beetroot powder, as well as the addition of orange oil, was effective in reducing food waste and creating a dish that was not only visually appealing but also had a good to excellent overall impression among the participants. The results also showed that the flavors were moderate to intense and very pleasing, while the texture and mouthfeel were somewhat pleasing.

Furthermore, the use of molecular gastronomy and note by note cooking techniques allowed for the precise control of flavors and textures, resulting in a well-balanced and innovative dish. This suggests that these techniques can be valuable in creating unique and sustainable dishes while reducing food waste. This is consistent with the literature, which has also shown that these techniques can be used to create innovative and sustainable dishes (Lam et al., 2016; Gómez-Sala et al., 2021).

Overall, this study provides valuable insights into the potential of using unconventional ingredients and modern cooking techniques in creating sustainable and flavorful dishes. The use of carrot tops, beetroot powder, and orange oil can be a valuable strategy in reducing food waste and creating innovative dishes that are both visually appealing and enjoyable to eat. Future research can explore further the potential of these ingredients and techniques and their effects on sustainability and reducing food waste in the food industry.

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## Logbooks

### Logbook 1

MODULE CODE: TFSC9025:2022-23

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Muhammad Kashif Inayat

FOOD PRODUCT: Carrotlicious

WEEK NO.: 1

### Weekly Aims:

- Introduction to note-by-note cooking principles
- Learning how to make spaghetti from tomato powder
- Understanding the concept of food as molecules

### Objectives:

- To create spaghetti from tomato powder
- To learn the principles of note-by-note cooking
- To understand the chemical composition of food

### Materials and Method:

Ingredients:

10 g tomato powder

Water, as needed

2.4g Agar Agar

Equipment:

Saucepan

Beater

Syringe and tube

Method:

In a saucepan, mix the tomato powder with enough water to thin it down to the consistency of tomato soup. Experiment with the amount of water to get the desired consistency.

Start heating the mixture and add agar agar. Let it heat until it starts boiling.

Fill a syringe with the tomato soup mixture and use it to fill the tubes that have been rolled and secured with a little adhesive tape.

Submerge the filled tubes in cold water so that the tomato soup sets in a few minutes.

With an empty syringe, inject air into the tube to obtain the spaghetti.

Results and Discussion:

During this week, I learned the principles of note-by-note cooking and how to make spaghetti from tomato powder. Note-by-note cooking is a new approach to cooking that focuses on the chemical composition of food rather than its traditional form. This approach allows us to create new flavors and textures by using only the essential components of food. By using tomato powder to create spaghetti, I was able to create a dish that was unique in taste and texture.

Conclusions:

In conclusion, this week was a great introduction to the principles of note-by-note cooking. I learned how to make spaghetti from tomato powder, which was a great example of how this approach can be used to create unique and innovative dishes. I am excited to continue exploring the concept of food as molecules and how it can be applied to molecular gastronomy.

LOGBOOK 2

MODULE CODE: TFSC9025:2022-23

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Muhammad Kashif Inayat

FOOD PRODUCT: Carrotlicious

WEEK NO.: 2

Weekly Aims:

- To learn and apply the principles of note-by-note cooking
- To create a sauce using only carrot tops

Objectives:

- To extract the necessary components from carrot tops
- To create a flavorful sauce using only carrot tops

Materials and Method:

Ingredients:

Carrot powder 20 g

Vanillin 1 g

Malic Acid 10 g

Carrot Top Extract 10 g

Ascorbic Acid 2 g

Equipment:

Small bowl

Blender

Small saucepan

Spoon

Method:

Combine 20 grams of Carrot Powder, 1 gram of vanillin, 10 grams of malic acid, and 2 grams of ascorbic acid in a small bowl. Mix well to combine.

Make carrot top extract (blending carrot tops with water and straining).

In a blender, combine 10 grams of carrot top extract with the dry mixture from step 1. Blend until smooth.

Transfer the mixture to a small saucepan and add water as needed to achieve the desired consistency. Heat over medium heat, stirring constantly, until the sauce is warmed through.

Add green color to get desired result.

Results and Discussion:

The sauce made using only carrot tops was a unique and flavorful creation. The use of note-by-note cooking principles allowed for the extraction of essential components from the plant, resulting in a sauce that was both sustainable and nutritious. The combination of carrot top extract with the dry mixture created a smooth and consistent sauce, which was further improved by adding green color.

Conclusions:

The principles of note-by-note cooking can be applied to reduce food waste and create unique dishes. The carrot top sauce is a perfect example of this, as it was created using only the tops of the carrot plant. The sauce was not only sustainable but also flavorful and nutritious.

LOGBOOK 3

MODULE CODE: TFSC9025:2022-23

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Muhammad Kashif Inayat

FOOD PRODUCT: Carrotlicious

WEEK NO.: 3

Weekly Aims:

To combine the spaghetti made from carrot powder and the sauce made from carrot tops to create a unique and sustainable dish.

Objectives:

To make Carrot Powder Spaghetti from the ingredients provided.

To make Carrot Top Pesto Sauce from the ingredients provided.

To combine the spaghetti and sauce to create a dish.

Materials and Method:

Carrot Powder Spaghetti:

Materials:

Saucepan

Beater

Syringe and tube

Adhesive tape

Ingredients:

10 g carrot powder

Water as needed

2.4 g Agar Agar

Orange oil (to taste)

Method:

In a saucepan, mix the carrot powder with enough water to thin it down to the consistency of tomato soup. Experiment with the amount of water to get the desired consistency.

Add the agar agar to the carrot soup mixture and stir to combine.

Bring the mixture to a boil, stirring constantly with a beater.

Remove the saucepan from heat and skim off any impurities that may have formed on top.

Add different colors to make multicolor spaghetti.

Fill a syringe with the carrot soup mixture and use it to fill the tubes that have been rolled and secured with a little adhesive tape.

Submerge the filled tubes in cold water so that the carrot soup sets in a few minutes.

With an empty syringe, inject air into the tube to obtain the spaghetti.

Add a few drops of orange oil to the spaghetti to give it a citrusy flavor.

Serve the carrot spaghetti hot or cold.

Carrot Top Pesto Sauce:

Materials:

Small bowl

Blender

Small saucepan

Spoon

Ingredients:

Carrot powder 20 g

Vanillin 1 g

Malic Acid 10 g

Carrot Top Extract 10 g

Ascorbic Acid 2 g

Method:

Combine 20 grams of Carrot Powder, 1 gram of vanillin, 10 grams of malic acid, and 2 grams of ascorbic acid in a small bowl. Mix well to combine.

Make carrot top extract (blending carrot tops with water and straining).

In a blender, combine 10 grams of carrot top extract with the dry mixture from step 1. Blend until smooth.

Transfer the mixture to a small saucepan and add water as needed to achieve the desired consistency. Heat over medium heat, stirring constantly, until the sauce is warmed through.

Add green color to get desired result.

LOGBOOK 4

MODULE CODE: TFSC9025:2022-23

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Muhammad Kashif Inayat

FOOD PRODUCT: Carrotlicious

WEEK NO.: 4

Weekly Aims:

To apply the principles of note-by-note cooking to a new dish.

To use 3D printing technology to create innovative food products.

Objectives:

To create 3D printed strawberries using beetroot powder and cherry flavor.

To combine the 3D printed strawberries with the spaghetti made from carrot powder and the sauce made from carrot tops.

Materials and Method (Ingredients, Equipment, and Method):

Ingredients:

**3D Printed Strawberries:**

5 grams citric acid

5 grams pectin

10 grams beet powder

Water, as needed

Cherry flavor

**Carrot Powder Spaghetti:**

10 grams carrot powder

Water, as needed

2.4 grams agar agar

Orange oil, to taste

**Carrot Tops Pesto Sauce:**

20 grams carrot powder

1 gram vanillin

10 grams malic acid

10 grams carrot top extract

2 grams ascorbic acid

Green color, as needed

Equipment:

Small bowl

Blender

Small saucepan

Spoon

Syringe and tube

Adhesive tape

Procusini 3D Printer

Method:

**3D Printed Strawberries:**

Dissolve 5 grams of citric acid in a small amount of water in a small bowl.

In a blender, combine the dissolved citric acid and beet powder. Blend until well combined.

Transfer the mixture to a small saucepan and add water as needed to achieve the desired consistency. Heat over medium heat and add pectin, stirring constantly, until the sauce is warmed through.

Continue to simmer the sauce until the desired thickness is achieved.

Add cherry flavor and mix well.

Using the ProCUSINI 3D Printer, print out the strawberry shapes using the beetroot mixture.

### **Carrot Powder Spaghetti:**

In a saucepan, mix the carrot powder with enough water to thin it down to the consistency of tomato soup.

Add the agar agar to the carrot soup mixture and stir to combine.

Bring the mixture to a boil, stirring constantly with a beater.

Remove the saucepan from heat and skim off any impurities that may have formed on top.

Add different colors to make multicolor spaghetti.

Fill a syringe with the carrot soup mixture and use it to fill the tubes that have been rolled and secured with a little adhesive tape.

Submerge the filled tubes in cold water so that the carrot soup sets in a few minutes.

With an empty syringe, inject air into the tube to obtain the spaghetti.

Add a few drops of orange oil to the spaghetti to give it a citrusy flavor.

### **Carrot Tops Pesto Sauce:**

Combine 20 grams of carrot powder, 1 gram of vanillin, 10 grams of malic acid, and 2 grams of ascorbic acid in a small bowl. Mix well to combine.

Make carrot top extract (blending carrot tops with water and straining).

In a blender, combine 10 grams of carrot top extract with the dry mixture from step 1. Blend until smooth.

Transfer the mixture to a small saucepan and heat over medium heat.

Add green food color as needed to achieve the desired color.

Simmer the sauce until the desired thickness is achieved.

**Reflection:**

This week's aim was to apply the principles of note-by-note cooking and use 3D printing technology to create an innovative food product. The dish "Carrotlicious" was created by combining 3D printed strawberries made from beetroot powder and cherry flavor, spaghetti made from carrot powder, and a pesto sauce made from carrot tops.

The process of making the 3D printed strawberries was interesting, as it required using a 3D printer to print the shapes using the beetroot mixture. The spaghetti made from carrot powder was also a unique experience, as it required using agar agar to create a gel-like texture that could be shaped into spaghetti using a syringe and tube.

The final dish looked visually stunning with the multicolored spaghetti and 3D printed strawberries. The taste was also impressive, with the sweetness of the strawberries complementing the savory pesto sauce and the citrusy flavor of the spaghetti.

Overall, this week's experiment was successful in applying the principles of note-by-note cooking and using 3D printing technology to create an innovative food product.

Pictures of Materials

