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FIPDes
Food Innovation & Product Design

Silkworm Kingdom

Note-by-note Dish

MODULE CODE: TFCS9021: 2024-25
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1. Introduction

In 2025, the population worldwide is approximately 8.2 billion (Worldometer, 2025). It is projected to grow to 10.3 billion by 2080 (United Nations, 2022). Up until that point, with the same amount of land and resources, the demand for food is surging exponentially (Phillips, 2024) to feed those who are in need of a nutritious and balanced diet (FAO, 2024). People need a balanced diet in their lifestyle, including carbohydrates, protein, fats, fiber, vitamins, minerals, and water (Sajid, 2020). Other macronutrients, such as carbohydrates, fats, fibers, and water, are naturally sourced and plentiful; however, proteins are scarce to combat those huge demands. There is a question lingering in mind: "What would be our Future food?"

Note-by-note cooking is a modern culinary technique in which dishes are prepared using pure chemical compounds instead of traditional ingredients. It was founded by Hervé This, a French physical chemist and co-founder of molecular gastronomy (This vo Kientza, 2021). He introduced the new concept of food, which was made from just chemical compounds and executed perfectly as an "art" dish. By combining the precision techniques along with compounds, no left-over food, no waste, and it is sustainable (Bazaar, 2011). It aligns with the 13th International contest for note-by-note cuisine: Food for the Future, which aims to "combat waste of ingredients, water or energy, while taking care of the environment" (INRAE, 2024). The theme for this year is to recreate the note-by-note dish which represents the food for the future.

Alternative proteins have been on a rise as scientists believe to be the answer to tackle the food insecurity (European Parliamentary Research Service, 2024). Novel foods include plant-based protein, algae, nuts/seeds, edible insects, mycoproteins, artificial meat and so on (National Academies of Sciences and Nicholson, 2022).

The inspiration of the edible insects prompts me to create a note-by-note dish for the future food. Many Asian countries have been consuming insects as part of their lifestyle, though not as their main meal, for a long time (Berendt, 2024). According to the European Union (European Parliament, 2023), the approved insects for food consumption include *Tenebrio molitor* larvae (the yellow mealworm), *Locusta migratoria* (the migratory locust), *Acheta domesticus* (the house cricket), and *Alphitobius diaperinus* (the lesser mealworm) in frozen, dried, or powder forms. However, in Southeast Asia, countries such as Thailand, insects have been a part of our life snacks with a burst of flavor from other seasonings, salt, chili, sugar, and so on (Lovgren, 2025). Though *Bombyx mori* (silkworm) is not EU approve for human consumption, as shown in Figure 1, Cambodian has already tried the insect and sold it nationwide. Singapore also approved the silkworm as an edible insect for food (Sullivan, 2024) so why not **Silkworm for the Future** across the globe.

Figure 1: Edible silkworms sold in Cambodia in the local market. (Alamy Limited, 2018)

2. Aim

The aim of this note-by-note dish is to explore the concept of Future Food by creating an alternative protein-based culinary experience using pure compounds and molecular gastronomy techniques. The dish is designed to represent a silkworm nest, composed of three key elements: the

soil, the pupae, and the silkworm. Each component is crafted using foam-like textures to reflect the delicate, natural forms found in an insect habitat. This project not only showcases the potential of edible insects as alternative protein sources but also emphasizes the role of science-driven gastronomy in shaping the future of food.

2.1. Objectives

The objectives of the note-by-note dish include:

- To promote alternative protein sources by highlighting the use of edible insects—specifically silkworms—as sustainable, high-protein ingredients suitable for future food systems.
- To utilize note-by-note cooking techniques and apply molecular gastronomy principles by using pure compounds to construct textures, flavors, and visual elements without relying on traditional whole ingredients.
- To replicate a silkworm habitat by visually and structurally mimicking a natural silkworm environment featuring edible representations of soil, larvae, and silkworms.
- To explore foam-based culinary structures using egg white powder, gelatin, glucose syrup, and emulsifiers to create lightweight, airy components.
- To communicate the concept of sustainable future food through plating and visual resemblance to insect ecosystems.
- To evaluate sensory acceptability on visual appeal, texture, aroma, and overall impression.
- To raise awareness of sustainable gastronomy and encourage the consideration of environmentally friendly ingredients and techniques by using pure compounds to create the dish

3. Materials and Methods

3.1. Ingredients

3.1.1. Crumbly soil

Table 1: The ingredient list for making the crumbly soil for the "Silkworm Kingdom" including the commercial name, chemical compound, brand name or supplier, reference picture, and the portion used to create the dish.

Ingredient	Compounds	Brand name	Reference picture	Amount used (g/ml)
Maltodextrin 12DE in powder	Maltodextrin	Sosa		1.5

Soy lecithin	Emulsifier: E322 (Soy lecithin)	PCB Creation		1.5
Cocoa powder	Alkalized cocoa powder 100%	DGF Royal		10
Cocoa butter	Cocoa butter 100%	DGF Royal		30
Banana aroma	Isomalt acetate (Ji and Srzednicki, 2015)	Sosa		0.15
Sugar	Sucrose	Gem	 (Tesco, 2025)	5

3.1.2. Silkworm larvae

Table 2: The list of ingredients to make the silkworm larvae, including the name, the compounds (based on packaging), the supplier, the picture of the ingredient, and the amount used for making the element in the Silkworm Kingdom.

Ingredient	Compounds	Brand name	Reference picture	Amount used (g/ml)
Egg white powder	Egg's albumin, Stabilizer (E415), Acidifier (E330), and Expansion agent (E1505)	Louis François		10
Glucose syrup	Inverted sugar	DGF Royal		10
Sugar	Sucrose	Gem	 (Tesco, 2025)	5
Gelatin powder	Beef Gelatin	Sosa		2
Water		Tap water		20

Mint aroma	Menthol	Sosa		0.15

3.1.3. Silkworm

Table 3: The ingredient list to make silkworms for the dish "Silkworm Kingdom" for the Future Food, including name, compounds, brand name of the product used, reference picture and the amount used in the dish.

Ingredient	Compounds	Brand name	Reference picture	Amount used (g/ml)
Egg white powder	Egg's albumin, Stabilizer (E415), Acidifier (E330), and Expansion agent (E1505)	Louis François		20
Glucose syrup	Inverted sugar	DGF Royal		10
Sugar	Sucrose	Gem	 (Tesco, 2025)	5

Gelatin powder	Beef Gelatin	Sosa		2
Water		Tap water		100
Watermelon aroma	(Z, Z) -3,6-nonadienal (Brunning, 2015)	Sosa		0.15
Yellow coloring	Coloring (E102)	Mallard Ferrière		0.15
Black berry powder	Freeze-dried blackberry in powder (Sosa, no date c)	Sosa		2
Maltodextrin 12DE in powder	Maltodextrin	Sosa		15

3.2. Equipment

Table 4: The equipment list that was used to create a Silkworm Kingdom dish as part of the theme Future Food, featuring the name, quantity, its brand and model, and the reference pictures of the equipment.

Equipment	Quantity	Brand/ Model	Reference Pictures
Whisk	1	Matfer 10”	 (Amazon Ireland, 2025)
Stainless steel mixing bowl (55cm)	4		
Precision Digital Pocket Scale	1	Logic Scale	 (Mister Smoke, no date)
Refrigerator	1	Polar G-Series Fridge 1200 L	 (Nisbets, no date a)
Stainless steel measuring jug (1L)	1	1L	
Kitchen aid	1	Maxima	

Piping bag	1	Vogue	 (Nisbets, no date c)
Copper pot	1	1L	 (Hendi, 2025)
Microwave	1	Samsung Light duty programmable CM1089	 (Nisbets, no date b)

3.3. Methods

3.3.1. Crumbly soil

To prepare the crumbly soil component, begin by boiling water in a copper pot and melting cocoa butter using the double-boil method. Place a stainless-steel mixing bowl over the boiling water and add the cocoa butter, allowing it to melt completely while stirring occasionally. Once fully melted, take out off the heat and gradually whisk in the cocoa powder until the mixture becomes smooth and fully homogenized. Next, add lecithin, maltodextrin, and sugar into the cocoa mixture along with a few drops of banana aroma to enhance the flavor. Whisk the mixture vigorously until it thickens into a cohesive paste. As the paste forms and begins to harden slightly, transfer it to the refrigerator for 30 to 45 minutes, or until it becomes solid. Once chilled and set, break the hardened mixture into small, irregular pieces to resemble soil. These pieces are then ready to be used for plating as part of the edible insect dish. All ingredients for crumbly soil can be found in Table 1.

3.3.2. Silkworm larvae

To create the foam for the larvae component, begin by mixing egg white powder with water and glucose syrup in a mixing bowl until the ingredients are well combined. Transfer the mixture into a KitchenAid stand mixer and whisk on high speed. This high-speed mixing is crucial, as it provides the necessary force to incorporate air into the mixture, helping to create a stable foam structure. In a separate small bowl, combine 2 grams of gelatin powder with 20 grams of water and warm the mixture in the microwave for about 30 seconds until the gelatin is fully dissolved. Once melted, carefully pour the gelatin solution into the KitchenAid bowl while the mixture continues to whip, ensuring it is evenly incorporated. At this stage, add a few drops of mint flavoring to infuse the foam with a refreshing aroma. Continue whisking until the foam has fully formed and holds its shape. Once the foam is stiffened, transfer into a piping bag and pipe it directly onto the soil component on the dish, shaping it to replicate the appearance of a larva nestled within the soil environment. While waiting for the last components to be plated (the silkworm), the dish included the soil and the larvae was chilled in the refrigerator to keep its form stable.

3.3.3. Silkworm

To create the mealworm component of the dish, begin by combining 2 grams of gelatin powder with 20 grams of water in a small bowl and warming it in the microwave for 30 seconds until the gelatin is fully dissolved. While the gelatin is heating, prepare the foam base by adding egg white powder, a small amount of yellow food coloring, sugar, glucose syrup, and maltodextrin into a mixing bowl. Whip this mixture using a KitchenAid stand mixer at high speed until it becomes fully aerated and light in texture. Once the gelatin solution has melted, slowly pour it into the whipping foam along with a few drops of watermelon aroma to enhance the sensory appeal. Continue mixing until the foam reaches a stiff consistency. Once ready, transfer the foam to a piping bag and carefully pipe worm-like shapes onto a sheet of parchment paper. Place the piped forms in the refrigerator and chill them to stabilize the foam structure. Once the foam worms have firmed up, use a soft brush dipped lightly in water and touched with blackberry powder to gently paint the surface, mimicking the segmented exoskeleton of a real worm. This should be done delicately to avoid collapsing the foam. Finally, when the detailing is complete, carefully lift each worm and plate them atop and around the prepared soil component to depict a naturalistic mealworm habitat, as illustrated in Figure 2.

4. Results

4.1 Final Dish

After three weeks of attempting to make the note-by-note dish to represent the Future Food, the final week showed a great success, though not aesthetically appealing, appearance-wise (Figure 2), it was executed as an appropriate final dish. It featured the crumbly soil with a mild banana aroma, the silkworm larvae with mint flavor, and the silkworm itself with watermelon aroma. All those flavor/aroma additives were inspired by the everyday foods that in Southeast Asia were abundant.

The image shows in Figure 2, a plated dish designed to represent a silkworm habitat, aligning with the theme of Future Food. At the center of the plate is a base layer of dark brown, crumbly soil-like texture, mimicking natural earth, likely made from a cocoa and compound mixture. Resting on and around the soil are several pale yellow, worm-like foam structures shaped to resemble silkworms and on top of their pupae. Light splashes of blackberry powder are brushed across some of the worm-like forms to create the effect of segmented exoskeletons, enhancing the visual realism. The dish as a whole is aiming to evoke the imagery of silkworms in their nest environment while showcasing the potential of alternative proteins and molecular techniques in future cuisine.

Figure 2: The final dish representation of the theme "Future Food" as "Silkworm Kingdom" that represent the alternative protein for future consumption.

4.2 Sensory Evaluation

By the end of week 4 of the note-by-note session, the sensory survey was conducted to evaluate the theme dish of “Future food”. As the inspired dish is called “Silkworm Kingdom”, the participants must rate the dish’s aspect such as appearance of overall dish, worm texture visually, the intensity of

the aroma from the worm, the liking of the soil taste and the overall acceptability of the whole cuisine The sensory survey followed the 5-Heidonic Scale Consumer Survey test (see details of the questionnaires in Appendix 1).

Due to time constraints, only 3 responses were recorded and as shown in Figures 3 to 7, the results varied from each category.

The appearance of the dish received positive feedback from participants. According to the pie chart in Figure 3, 67% of respondents rated the appearance as “Like,” while the remaining 33% rated it as “Just about right.” This suggests that the dish successfully conveyed its visual concept of an insect-based future food. None of the participants expressed negative reactions, indicating a strong level of visual satisfaction.

Regarding the visual texture of the silkworm foam (Figure 4), 67% of participants described it as “Very fluffy,” and 33% as “Fluffy.” These results demonstrate the effectiveness of the revised foaming technique using egg white powder, gelatin, glucose syrup, and maltodextrin. The consistent ratings across participants confirm that the foam visually mimicked a soft, worm-like structure, supporting both aesthetic and technical goals of the dish.

The evaluation of the soil component’s taste, shown in a donut chart, revealed balanced feedback. About 34% of participants rated it as “Like very much,” 33% rated it as “Like,” and another 33% responded with a “Neutral” opinion. While no participant rated it negatively, the equal distribution suggests the flavor profile, comprising cocoa, sugar, maltodextrin, and banana aroma, was generally pleasant but perhaps could benefit from slight adjustments to better suit varying taste preferences.

The aroma intensity of the watermelon flavor in the silkworm foam in Figure 6 was mostly perceived as “Strong” by the participants, with two out of three individuals selecting this rating, and one choosing “Just about right.” No participants found the aroma weak, suggesting that the watermelon flavor was present and noticeable. However, since none rated it “Very Strong,” the aroma intensity appears well-controlled and did not overpower the overall dish.

The overall sensory acceptance of the Silkworm Kingdom dish was entirely positive (Figure 7). All three participants rated the dish as “Good,” with no responses in the “Neutral,” “Fair,” or “Poor” categories. This 100% approval rate highlights the successful execution of the concept in terms of flavor, texture, and visual storytelling.

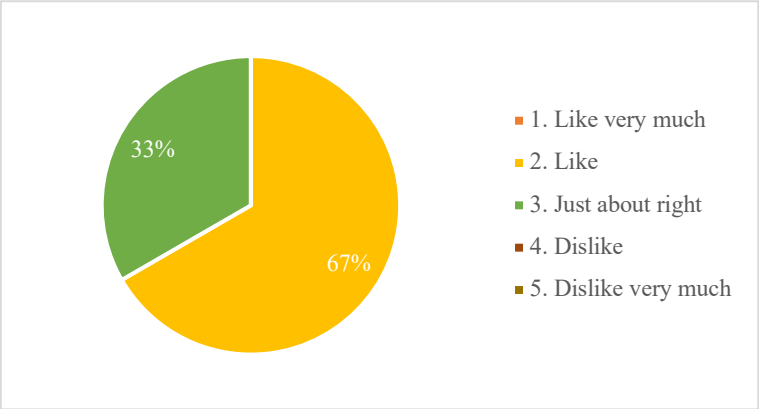

Figure 3: The sensory rating of the appearance of the overall dish, the Silkworm Kingdom.

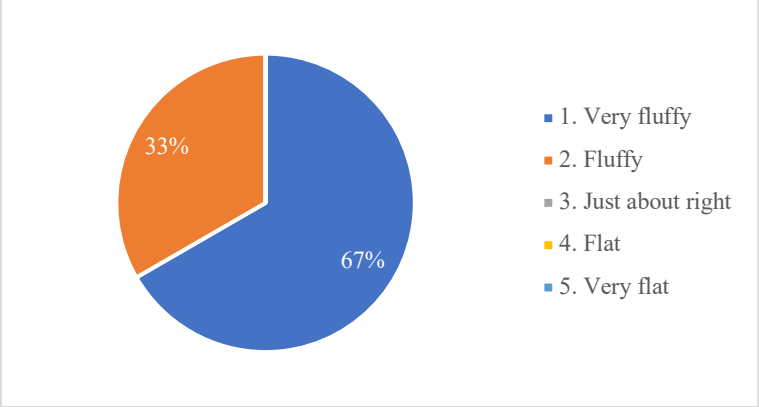

Figure 4: The rating of the visual assessment toward the texture of the silkworm that present on the final dish.

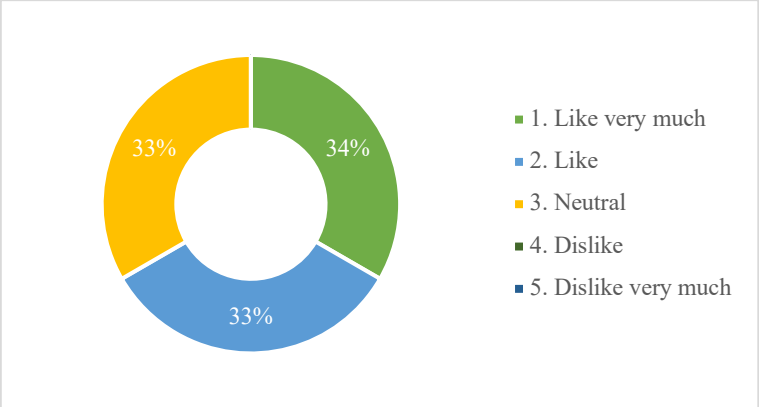

Figure 5: The taste testing result on the soil of the "Silkworm Kingdom" by sensory evaluation.

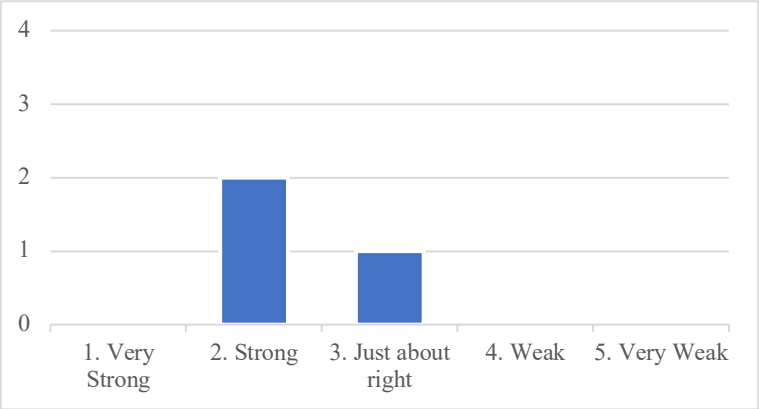

Figure 6: The aroma intensity of the watermelon which reside in the silkworm on the dish.

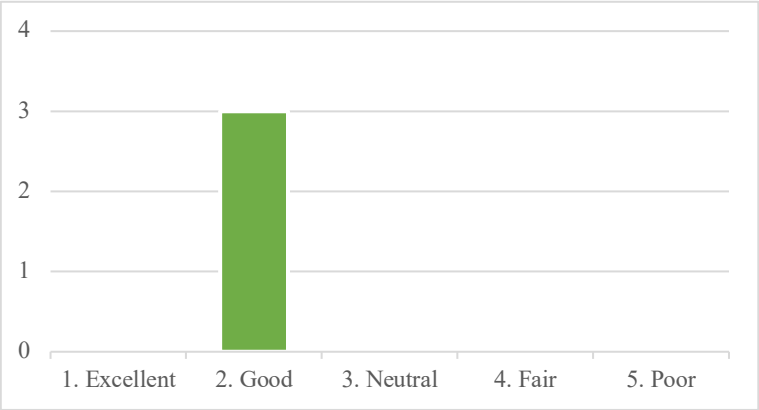

Figure 7: The sensory rating on the overall acceptability of the whole dish, the Silkworm Kingdom.

5. Discussions

The struggling in making the Silkworm Kingdom through note-by-note cooking proved as a challenge in executing the dish. By using the pure compounds to make foam instead of usual protein (i.e. egg whites), resulted in an unstable structure.

Foam is a substance formed by trapping gas bubbles in a liquid or solid. It typically appears light, airy, and bubbly, and can occur naturally or be manufactured. There are two main types: liquid foam, gas bubbles dispersed in a liquid (e.g., soap foam, whipped cream, beer head) and solid foam, gas bubbles trapped in a solid matrix (e.g., foam rubber, Styrofoam, sponge) (Tikkanen, no date). In food, liquid foam is usually made by incorporating air with mechanical speed to form a texture and presentation like in mousses whipped topping and with N_2O gas (using a siphon gun). It's formed when air is introduced and stabilized by proteins or other surfactants that reduce surface tension.(Boukid and Gagaoua, 2022)

In the first week, using the foaming agent Albuwhip and inspired by its supplier recipe (Sosa, no date a), the Italian meringue attempted using the foaming agent and altered lemon juice to citric acid led to a liquid-like foam that was not stable. Agar Agar, gelatine, and soy lecithin have been recommended to act as a foaming agent in substitution of the egg white foam (Science of Cooking, no date). Different egg-white substitutes for food foam, such as aquafaba, egg white protein (albumin) powder, lecithin (soy or sunflower), foaming agents: albuwhip, ultrawhip, gelatine have been explored (Great British Chef, 2015), (Federation of European Specialty Food Ingredients, 2024), (Laursen *et al.*, 2025).

In the final dish, egg white powder was used as a foam base for both the larvae and the silkworm. Egg white powder contains albumin, which is responsible for creating foam through air

incorporation during whipping. While egg whites alone can form foams, they tend to be unstable and prone to collapse. Gelatin helps reinforce the foam structure by forming a gel matrix around the air bubbles, thereby reducing drainage and coalescence of the foam over time(Rather *et al.*, 2022). Maltodextrin is a polysaccharide often used as a bulking agent and stabilizer in food systems. In foaming applications, maltodextrin contributes by absorbing excess moisture and increasing the viscosity of the liquid phase, which slows down the collapse of air bubbles (BeMiller, 2003).

The sensory survey results indicate that the Silkworm Kingdom dish was well-received across all evaluated aspects. The visual execution, particularly of the foam and soil elements, was effective in representing the theme of future food. The positive feedback on texture and acceptability confirms the success of the revised recipe for the silkworm foam. While the flavor of the soil component received slightly more varied ratings, it still maintained favorable impressions. Going forward, refining the balance of flavor intensity while maintaining the strong visual and textural performance could further elevate the dish.

According to Regulation (EC) No 1333/2008, food additives such as aroma/flavor (watermelon, banana, and mint), coloring (yellow), and emulsifier (Lecithin) are subjected to dose limitation. The yellow coloring (E102) that was used is within the permitted level (100mg/kg), Annex II Regulation (EC) No 1333/2008. As for emulsifier (lecithin, E322), its specific maximum level is *quantum satis*, which means it can be used in quantities necessary to achieve the intended purpose, provided it does not mislead consumers or pose a safety risk, Annex II Regulation (EC) No 1333/2008. For aroma/flavor, its dosage was within the limits of its supplier's packaging such as banana, watermelon, and mint (0.2g/kg)(Gourmet Versand, no date), (Sosa, no date b). Maltodextrin, gelatin, egg white powder, and glucose syrup are categorized as food ingredients rather than additives, which are only governed by the general food safety and labeling requirements.

6. Conclusion

In conclusion, the "Silkworm Kingdom" dish successfully demonstrates the potential of pure compounds in advanced molecular gastronomy to replicate edible insect forms and convey a compelling narrative around future food. Using egg white powder, gelatin, glucose syrup, and flavor compounds, stable foams were created to mimic the texture and appearance of silkworms and their habitat. Sensory evaluations showed strong visual appeal, satisfying texture, and high overall acceptability, confirming the dish's technical and conceptual success. However, as foam is inherently less stable than other structures such as gels or emulsions, achieving consistent results using only pure chemical compounds within a four-week timeframe proved challenging. Therefore, further research and experimentation are recommended to explore additional ingredients and methods that may enhance foam stability and functionality in molecular gastronomy applications.

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8. Appendix

Appendix 1: The list of questionnaires that were provided for the participants when doing the sensory evaluation by the end of the session.

Do you like the appearance of the overall dish? ¡ 1. Like very much ¡ 2. Like ¡ 3. Just about right ¡ 4. Dislike ¡ 5. Dislike very much
Visually, what do you think about the texture of the silkworm? ¡ 1. Very fluffy ¡ 2. Fluffy ¡ 3. Just about right ¡ 4. Flat ¡ 5. Very flat
How do you like the taste of the soil? ¡ 1. Like very much ¡ 2. Like ¡ 3. Neutral ¡ 4. Dislike ¡ 5. Dislike very much
Rate the intensity of the watermelon of the silkworm. ¡ 1. Very Strong ¡ 2. Strong ¡ 3. Just about right ¡ 4. Weak ¡ 5. Very Weak
Overall acceptability, how do you rate the dish? ¡ 1. Excellent ¡ 2. Good ¡ 3. Neutral ¡ 4. Fair ¡ 5. Poor
Any comment? _____

9. Logbooks

MODULE CODE: TFCS9025

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Sekhaveayeam Hoeung

FOOD PRODUCT: Alternative protein for the Future Food

WEEK NO.: 1 **DATE: 18-Mar-2025**

Weekly Aims and Objectives

Aim:

- To make a note-by-note dish that represent the Future Food as alternative protein (mealworms, cricket and tarantula)

Objectives:

- To make mousse for tarantula body and agar agar for tarantula legs
- To make foam and form mealworms with mango powder and yellow coloring
- To produce crumbly soil with banana flavouring and grass with matcha powder and green coloring
- To make foam cricket with siphon gun by using blueberry powder and cricket legs with baking sugar into crispy tuille

Materials and Method (Ingredients, Equipment and Method)

For Crumbly soil:

Ingredient:

- Maltodextrin 1.5g (Sosa)
- Soy Lecithin 1.5g (PCB Creation)
- Cocoa powder 15g (DGF Royal)
- Cocoa butter 30g
- Banana aroma 3 drops (Sosa)
- Sugar 5g (Gem)

Equipment:

- Stainless steel bowl
- Whisk
- Copper pot

Method:

1. Melt cocoa butter and add cocoa powder
2. Mix lecithin, maltodextrin and sugar together to form paste
3. Refrigerated to form solid and crumbled.

For Grass (Italian meringue like):

Ingredients:

- Matcha powder 5g
- Albuwhip 5g +5 (Sosa)
- Green coloring 3 drops (Mallard ferrière)

- Sugar 50 (Gem)
- Trehalose powder 50g (Innovative Naturopathics)
- Citric acid 3g
- Water 100 + 50

Equipment:

- Kitchen aid
- Pot
- Pipping bag

Method:

1. Mix albuwhip with citric acid and matcha powder and water 100g and put into kitchen aid to whisk
2. Mix sugar, water 50g, and trehalose powder with green coloring together and let it cook until 120C
3. Add the whisk of albuwhip with citric acid into the cooked mixture and gently fold until it is fully dispersed
4. Transfer to piping bag and pipe down and shape as grass on top of the crumbly soil

For Tarantula (Mousse like texture):

Ingredients:

- Cocoa powder
- Agar Agar
- Water
- MSK Ultrawhip
- Maltodextrin

Equipment:

- Siphon gun
- N_20 Charger
- Whisk

Method:

1. Mix Cocoa powder in water to dissolve completely and add maltodextrin to sweeten the mixture.
2. Add MSK Ultrawhip and agar agar into the cocoa water mixture
3. Add the mixture of cocoa powder, water, maltodextrin and MSK ultrawhip into the siphon gun, attach the cream charge and charge
4. When it shape like a tarantula body, chill in the fridge.
5. For the tarantula legs, mix agar agar with water and cocoa powder and heat it up until 65C
6. Take it off the heat, let it cool a bit and use syringe to suck in the mixture and pump out the mixture and shape its leg on a parch paper and cool it down in blast freezer.

For meal worms:

Ingredient:

- Mango powder 15

- Water 100g
- Egg white powder 10g +10g (Louis François)
- Yellow coloring 5 drops (Mallard ferrère)
- Sugar 15g
- Blueberry powder

Equipment:

- Pipping bag
- Oven
- Kitchen aid

Method:

1. Add mango powder, water, msk eggless, yellow coloring and sugar into a bowl
2. Whip the mixture with kitchen aid until it's fully aerated
3. Transfer to piping bag, shape on parchment paper into worm like
4. Set the oven to 130C for 5 min and bake the meringue-like worm.
5. Cool it down, and paint the worm with blueberry powder at the section

For cricket:

Ingredient:

- Blueberry powder
- Citric acid
- Sugar
- Lecithin
- MSK Ultrawhip
- Water

Equipment:

- Hand mixer
- Kitchen aid

Method:

1. Mix blueberry powder with water, sugar, citric acid in a bowl
2. Add ultrawhip into the mixture and whisk with hand mixer
3. Transfer to piping bag and shape the cricket body on parchment paper
4. For the cricket wing, mix lecithin, blueberry powder, citric acid, and sugar and whisk until it foam
5. Spread thinly on the parchment paper and bake in the over
6. For its leg, mix sugar in water and cook, shape into leg and bake until it crisp
7. Let it cool down and assemble

Results and discussion

The crumbly soil component of the dish was one of the more successful elements in this week's attempt. Inspired by culinary arts program alumna Sophie Dalton, the recipe was simplified to include only essential ingredients: cocoa powder, cocoa butter, lecithin, sugar, maltodextrin, and banana aroma. Cocoa powder provided the rich, earthy color of soil, while cocoa butter and lecithin acted as emulsifiers and fat globules (when melted) to help bind the ingredients into a paste-like texture. Sugar

and maltodextrin contributed to a more balanced sweetness and a better mouthfeel, and the addition of banana aroma gave the soil a pleasant, indulgent flavor profile. Though sugar and maltodextrin was added to the recipe to sweeten the soil elements, when tasting, it was too bitter and the chocolate flavor was overpowering.

For the grass element, the approach was inspired by a Sosa-based recipe and involved replicating Italian meringue using pure compounds. Albuwhip served as the foaming agent, chosen for its ability to generate a stable foam when whipped. Citric acid was substituted for lemon juice, but this resulted in a harsh sourness and slight bitterness, which was not ideal in terms of flavor. Trehalose powder was used as a safer alternative sugar, and the sugar mixture, heated with water to 120°C, formed a slimy, syrup-like consistency, ideal for meringue. Matcha powder was added both for its natural green color and its subtle, earthy flavor. Although the foam was initially difficult to rise, it eventually did and was transferred into a piping bag and chilled. However, the foam lacked long-term stability; it collapsed soon after, and the sugar mixture began to ooze from the bag. As seen in Figure 1, the piped “grass” failed to hold its shape and fell apart on the soil. This instability was likely due to insufficient protein network formation and poor water retention, both of which are essential to maintaining foam structure over time.

An additional attempt was made to create a mealworm-infused meringue using egg white powder in place of fresh egg whites. This mixture included mango powder, water, and sugar. However, the final solution was too dense for the KitchenAid mixer to whip into foam. As shown in Figure 2, the result was a flat, unstructured liquid. There was not enough time to attempt the recipe again, but it was suggested that using a hand mixer or incorporating an emulsifier like xanthan gum or lecithin could help form a cohesive paste before whipping, potentially leading to a better result.

Due to time constraints, the remaining insect components, cricket and tarantula, were not prepared or incorporated into the final dish. This significantly impacted the completeness and conceptual balance of the plate (Figure 1). Better time management and preparation strategies will be essential in future attempts to ensure all components are executed and assembled as planned.

Figure 1: The final dish presentation of the edible insect cuisine with the black crumble is edible soil and the green foam is intended grass.

Figure 2: The fail attempt of making a foam to form a mealworm.

Conclusions

In conclusion, the first week's attempt at creating an alternative protein dish featuring edible insects can be considered a failure overall, except for the soil component, which I found successful and would like to include again. I also intended to include tarantula, cricket, and mealworm, though the time constraint was a challenge. On the other hand, the Italian meringue-like foam made from Albuwhip was a partial success; although it took time to foam, it did eventually reach the desired texture, but unfortunately lacked stability over time. Moving forward, I plan to manage my time more effectively to ensure all elements of the dish are completed and better integrated.

Recommendations for following week.

- To add xanthan gum to the "Grass" recipe to make stable foam.
- To decrease citric acid in Grass recipe from 3 g to 0.3 g
- To decrease the cocoa powder from 15g to 10g to balance between the sweetness and the bitterness of the dish
- To create a Tarantula with a siphon gas
- To successfully make a mealworm meringue
- To make cricket foam using siphon gas

Ingredients required for the following 2 weeks.

MODULE CODE: TFCS9025

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Sekhaveayeam Hoeung

FOOD PRODUCT: Alternative Protein for the Future Food

WEEK NO.: 2 **DATE: 24-Mar-2025**

Weekly Aims and Objectives

Aim:

- To make a note-by-note dish that represents the Future Food as an alternative protein (mealworms, cricket, and tarantula)

Objectives:

- To add xanthan gum to the “Grass” recipe to make stable foam.
- To decrease citric acid in Grass recipe from 3 g to 0.3 g
- To decrease the cocoa powder from 15g to 10g to balance between the sweetness and the bitterness of the dish
- To create a Tarantula with a siphon gas
- To successfully make a mealworm meringue
- To make cricket foam using siphon gas

Materials and Method (Ingredients, Equipment, and Method)

For Crumbly soil:

Ingredient:

- Maltodextrin 1.5g (Sosa)
- Lecithin 1.5g (PCB Creation)
- Cocoa powder 10g (DGF Royal)
- Cocoa butter 30g
- Banana aroma 3 drops (Sosa)
- Sugar 5g (Gem)

Equipment:

- Stainless steel bowl
- Whisk
- Copper pot

Method:

1. Melt cocoa butter and add cocoa powder
2. Mix lecithin, maltodextrin and sugar together to form a paste
3. Refrigerated to form a solid and crumbled the mixture.

For Grass (Italian meringue like):

Ingredients:

- Matcha powder 5g
- Albuwhip 10g (Sosa)
- Green coloring 3 drops (Mallard ferrière)
- Sugar 50 (Gem)
- Trehalose powder 50g (Innovative Naturopathics)
- Citric acid 0.3g
- Water 150g
- Xanthan gum 1.5g (Sosa)
- Mint flavor 5 drops

Equipment:

- Kitchen aid
- Pot
- Pipping bag

Method:

1. Mix albuwhip with citric acid, matcha powder, and water 100g and put into kitchen aid to whisk, along with the xanthan gum.
2. Mix sugar, water 50g, and trehalose powder with green coloring together and let it cook until 120°C
3. Add gently the trehalose powder mixture into the kitchen aid and whisk until it is fully dispersed
4. Transfer to piping bag and pipe down and shape as grass on top of the crumbly soil

For Tarantula (Mousse like texture):

Ingredients:

- Purple coloring 5 drops
- Agar Agar
- Water
- MSK Ultrawhip 5g
- Maltodextrin 5.3g
- Ultragel 3g
- Cocoa powder 5g

Equipment:

- Siphon gun
- N_20 Charger
- Whisk

Method:

1. Mix Cocoa powder in water to dissolve completely and add maltodextrin to sweeten the mixture.
2. Add MSK Ultrawhip and ultragel into the cocoa water mixture
3. Add the mixture of cocoa powder, water, maltodextrin and MSK ultrawhip into the siphon gun, attach the cream charge and charge
4. When it is shaped like a tarantula body, chill in the fridge.
5. For the tarantula legs, mix agar agar with water and cocoa powder and heat it up until 65C
6. Take it off the heat, let it cool a bit and use syringe to suck in the mixture and pump out the mixture and shape its leg on a parch paper and cool it down in blast freezer.

For mealworms:

Ingredient:

- Water 100g
- Egg white powder 10g +10g
- Yellow coloring 5 drops
- Sugar 15g
- Blueberry powder
- Gelatine leaf
- Maltodextrin 15g

Equipment:

- Pipping bag

- Oven
- Kitchen aid

Method:

1. Heat gelatine leaf until it is fully dissolved
2. Add into the water, egg white powder, yellow coloring sugar, and maltodextrin into a bowl
3. Whip the mixture with kitchen aid until it's fully aerated
4. Transfer to piping bag, shape on parchment paper into worm-like
5. Set the oven to 130C for 5 min and bake the meringue-like worm.
6. Cool it down, and paint the worm with blueberry powder at the section

For cricket:

Ingredient:

- Blueberry powder
- Citric acid
- Sugar
- Lecithin
- MSK Ultrawhip
- Water

Equipment:

- Hand mixer
- Kitchen aid

Method:

1. Mix blueberry powder with water, sugar, citric acid in a bowl
2. Add ultrawhip into the mixture and whisk with hand mixer
3. Transfer to piping bag and shape the cricket body on parchment paper
4. For the cricket wing, mix lecithin, blueberry powder, citric acid, and sugar and whisk until it foam
5. Spread thinly on the parchment paper and bake in the over
6. For its leg, mix sugar in water and cook, shape into leg and bake until it crisp
7. Let it cool down and assemble

Results and discussion

This week's testing yielded mixed results, with some improvements in individual components but continuing challenges with stability and time management. The crumbly soil element stood out as a success. By reducing the cocoa powder from 15g to 10g, the soil achieved a better balance of sweetness and bitterness, making it more palatable. The inclusion of banana aroma added a mild, pleasant undertone, resulting in a flavorful and edible base for the dish.

The grass element, however, remained problematic. Despite modifying the mixture by adding xanthan gum in hopes of stabilizing the foam, the result was similar to the mealworm attempt from Week 1, there was still no foam formation. Even with hand mixing, the mixture failed to hold any structure. Upon incorporating the cooked sugar mixture, the foam transformed into a thick paste instead of aerating. The more it mixed in the KitchenAid, the thicker the mixture became, which did not improve the consistency. To salvage the situation, the paste was transferred into a piping bag and shaped to resemble blades of grass on parchment paper, then baked at 160°C for 2 minutes. As seen

in Figure 1, the final product was edible, but the overpowering mint flavor left a lingering aftertaste that was too strong and unbalanced the dish.

The tarantula component showed visual promise but fell short in texture. Using a siphon gun to shape the spider form gave an initially eye-catching result, though an unexpected purple color emerged due to the lack of brown coloring and the overuse of purple dye. While the form was visually interesting, the texture leaned toward a gel-like consistency rather than a structured foam. A small amount of air was incorporated, but when the spider was chilled in preparation for plating, the texture deteriorated. During plating, the tarantula collapsed and lost its shape, resembling a puddle rather than a mousse-like foam, highlighting a need for better structural integrity in future iterations.

Time constraints once again limited the ability to address or revise the mealworm recipe, and the cricket element was not attempted at all. Future sessions will require a narrower focus, prioritizing the refinement of one or two elements at a time to allow for deeper experimentation and better results.

Figure 1: The final presentation of the alternative protein as future food featuring crumbly soil, grass and tarantula (failed attempt).

Conclusions

This week's attempt revealed several challenges in both execution and time management. The dish included too many complex elements to complete within the limited timeframe, and it would be more feasible to focus on presenting just one edible insect per dish moving forward. The revised Italian meringue recipe, which included xanthan gum, was unsuccessful—it failed to foam entirely, indicating that a new formulation must be developed. Additionally, the tarantula's body had an overly gel-like consistency and was unable to hold its structure, further affecting the final presentation. Due to these issues, there was not enough time to attempt the inclusion of mealworms or crickets. In future trials, a new foam recipe will be explored, and the scope of the dish will be refined to allow for more focused and achievable outcomes.

Recommendations for following week.

- Rethink the elements of the edible insect and focus only on one insect, which is the mealworm
- Reduce the elements of the dish from 5: soil, grass, mealworm, tarantula, and cricket to only 3 elements such as soil, grass and mealworm instead.
- To reduce the mint flavor in grass recipe from 5 drops to 2 drops
- To add flavor to the mealworm with watermelon flavor/aroma.

Ingredients required for the following 2 weeks.

- Watermelon aroma

MODULE CODE: TFCS9025

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: Sekhaveayeam Hoeung

FOOD PRODUCT: Mealworm Kingdom

WEEK NO.: 4 **DATE: 24-Mar-2025**

Weekly Aims and Objectives

Aim:

- To make a mealworm kingdom that represents the Future Food as an alternative protein

Objectives:

- Reduce the elements of the dish from 5: soil, grass, mealworm, tarantula, and cricket to only 3 elements such as soil, grass and mealworm instead.
- To reduce the mint flavor in grass recipe from 5 drops to 2 drops
- To add flavor to the mealworm with watermelon flavor/aroma.

Materials and Method (Ingredients, Equipment, and Method)

For Crumbly soil:

Ingredient:

- Maltodextrin 1.5g
- Lecithin 1.5g
- Cocoa powder 10g
- Cocoa butter 30g
- Banana aroma 3 drops
- Sugar 5g

Equipment:

- Stainless steel bowl
- Whisk
- Copper pot

Method:

1. Melt cocoa butter and add cocoa powder
2. Mix lecithin, maltodextrin and sugar together to form paste
3. Refrigerated to form solid and crumbled.

For larvae:

Ingredients:

- Egg white powder 10g
- Glucose syrup 10g
- Sugar 5 g
- Gelatin 2g
- Water 20g
- Mint flavor 0.15 ml

Equipment:

- Kitchen aid
- Pot
- Pipping bag

Method:

1. Mix egg white powder with water and glucose syrup and transfer to kitchen aid to whisk
2. Add water 20g to 2g of gelatin powder and warm in microwave for 30 seconds
3. Add gelatin solution into the mixture while mixing along with mint flavor
4. The foam is formed. Transfer to piping bag and pipe onto the soil on the dish.

For mealworms:

Ingredient:

- Water 100g
- Egg white powder 20g
- Yellow coloring 3 drops
- Sugar 5g
- Blueberry powder 2g
- Gelatine 2g
- Maltodextrin 15g
- Glucose syrup 10g
- Watermelon aroma 0.15 ml

Equipment:

- Pipping bag
- Oven
- Kitchen aid

Method:

1. Add water 20g to 2g of gelatin powder and warm in the microwave for 30 seconds
2. Add into the water, egg white powder, yellow coloring sugar, and maltodextrin with watermelon aroma into a bowl
3. Whip the mixture with kitchen aid until it's fully aerated
4. Transfer to piping bag, shape on parchment paper into worm-like
5. Cool in the refrigerator, waiting for plating.
6. When plating, take blueberry powder to paint an exoskeleton of the worm for better presentation.

Results and discussion

The final dish evolved slightly from its original concept of mealworm, soil, and grass to a more cohesive and visually coherent representation of soil, larvae, and mealworm, as shown in Figure 1. This change was driven by the performance of various recipes trialed in Weeks 1 and 2, particularly the repeated failure of foams formed using foaming agents like albuwhip. As a result, a new approach was implemented using egg white powder as the base, which contains the same proteins as fresh egg whites and is capable of producing stable foams when combined with gelatin and glucose syrup.

Glucose syrup played a crucial role by improving viscosity and supporting air incorporation during whipping, while also helping prevent crystallization, which could otherwise destabilize the

foam. Sugar added both sweetness and structural body, while gelatin contributed elasticity and helped retain air, giving the foam volume and resilience. Maltodextrin functioned as a bulking agent and helped dry out excess moisture, further stabilizing the foam structure.

The resulting mealworm form was visually stable and retained its foam structure even after chilling, indicating that the combination of ingredients and chilling was effective in prolonging foam integrity. Painting the mealworm's exoskeleton with blueberry powder enhanced its realism and made the insect representation more recognizable and visually striking. Both the mealworm and larvae were created using the same foaming base, with only the flavorings altered, mint for the larvae and watermelon for the mealworm, to diversify the aroma and add contrast to the dish.

Figure 1: The final presentation of the mealworm kingdom feature the soil, the larvae of the mealworm and the mealworm itself.

A visual sensory evaluation was conducted with three participants with short timing. As shown in Figure 2, all participants responded positively to the dish's appearance. When questioned about the mealworm's texture, all three described it as "Very fluffy" and "fluffy," affirming the success of the foaming method (Figure 3). Chilling was also confirmed to help preserve the form and texture, contributing to the overall visual impact and structural stability.

The dish received a 100% approval rate from participants in terms of overall acceptability. This iteration marks a significant success, demonstrating that with revised techniques and refined recipes, it is possible to execute a visually compelling and conceptually strong dish that aligns with the vision of "Future Food."

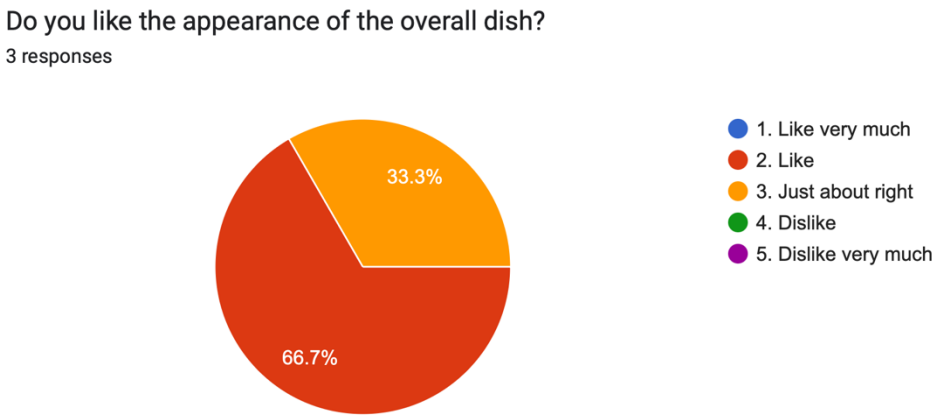

Figure 2: The sensory evaluation of the dish based on the appearance.

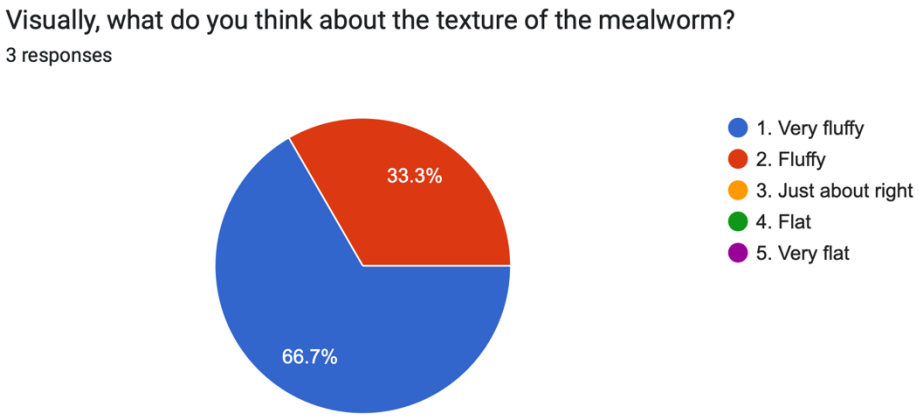

Figure 3: The sensory rating of the mealworm by visual.

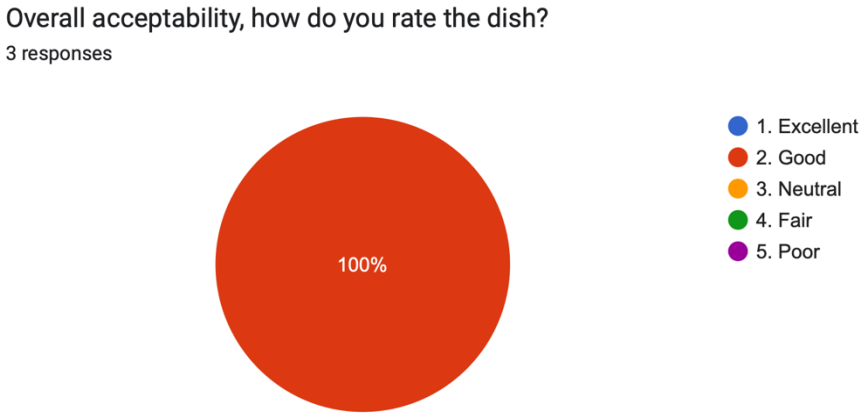

Figure 4: The overall acceptability of the dish by sensory evaluation.

Conclusions

In conclusion, by limiting the number of elements in the dish, a more focused and coherent representation of the edible insect concept was achieved through the creation of a mealworm habitat, featuring the soil, the larvae, and the mealworm itself. This refined approach allowed for greater attention to detail and resulted in an overall presentation that was satisfactory both personally and among other sensory participants. The sensory evaluation was primarily based on visual inspection, as the execution of the "Future Food" theme relied heavily on effectively communicating the concept through appearance. Importantly, this dish not only highlighted edible insects as a sustainable protein source but also emphasized the role of pure compounds in shaping the sensory and structural qualities of food, reinforcing their significance in the future of gastronomy.