LAB low food

Low Food Lab:

mycelium

In this Low Food Lab, everything revolves around mycelium, the root network of fungi – not as a meat substitute, but as a fully fledged ingredient with unique possibilities.

About Low Food

Low Food aims to demonstrate how good and delicious food can have an impact, with taste as the key to change. Through research, education and inspiring events, we reveal how everyone has a role to play and how everyone can contribute to improving the food chain. Together, we can put Dutch gastronomy on the map and encourage exchange throughout the entire food chain: exchange between chefs, product developers, farmers, retailers and consumers and beyond. We focus on high-impact themes: reducing food waste, promoting a more plant-based diet and increasing biodiversity. We want to stress that a career in food is a powerful way to make a sustainable impact. Our ambition is to ensure that culinary developments and innovations reach a wider audience more quickly. To that end, we collaborate with partners such as Flevo Campus, Deloitte, Vermaat and SOL, who each supply their unique expertise and/or represent different parts of the food chain.

The Low Food Lab unites culinary knowledge, knowledge of our food system and product development. The labs are a place where chefs, food scientists, artists, product developers and others are brought together to find potential, new uses for food made from new or forgotten ingredients, ultimately aiming to contribute to fairer, healthier, more diverse and more sustainable eating habits. That's why, in the Labs, we work on food issues for which a culinary solution must be found, such as smarter ways to valorise residual waste flows and the development of applications that make certain ingredients accessible to a wider audience. In previous labs, we researched the potential of grass protein, feed wheat, chicken waste and more.

See www.lowfood.nl for more information.

About Flevo Campus

Flevo Campus is an innovative knowledge centre dedicated to improving urban food systems. Through research, analysis, interventions and knowledge programmes, Flevo Campus makes an impact on what and how we will eat tomorrow. Guus Nelissen, a project manager at Flevo Campus, explains: "At Flevo Campus, we address a variety of food-chain issues through research, innovation and experimentation. We have an interdisciplinary approach, which means that we link up with a variety of parties to come up with new, creative solutions. We don't just leave the research to the scientists: we also rope in food entrepreneurs and professional chefs. Flevo Campus sees a lot of potential in Low Food Lab's experimental research, which investigates food issues from a gastronomic perspective. In other words: what tastes good; what works and what doesn't? Historically, these questions have been the source of most of today's culinary knowledge and food innovations – all driven by the ambition and willingness of chefs and small-food entrepreneurs to look at food in a different way.

The alliance with the province of Flevoland is also key; Flevoland is one of the main food-producing provinces in the Netherlands. Food security and improving the sustainability of our food and agricultural system are hot topics at the moment. This region, in particular, is facing a number of challenges in those areas, for which Low Food Labs could provide a solution."

See www.flevocampus.nl for more information.

From left to right: Jonah Koppe, Thomas Val, Yacinth Pos, Rene van der Weijden, Craig Johnston, Sebastiaan Aalst, Tessa van der Geer, Wendy Luong, Guus Nelissen, Ayane Kogure, Michael Kilkie, Annemarijn Verboom, Sabine Schäfer, Eyad Khamis, Emile Samson, Edwin Berends.

Introduction by Tessa van der Geer, Head of Lab

THE TERM "PROTEIN TRANSITION" NEVER REALLY WORKED FOR ME. THIS ISN'T A PROTEIN CHALLENGE – IT'S A SOURCING CHALLENGE. The average Dutch diet isn't lacking in protein; the real challenge is shifting from predominantly animal-based sources to plant-based alternatives. Too often, this shift relies on imitation. Meat replacements promise familiarity but often fall short. And when the experience disappoints, curiosity fades. That's why I believe in a different approach: creating plant-based products that don't try to mimic but are simply delicious in their own right. This is why I challenged the team to go beyond the meat analogue.

Mycelium is a promising protein alternative. The rootlike structure of fungi is beautiful in texture but has little taste. As chefs, we are trained to make ingredients shine. Mycelium, however, is a foundation – a carrier of taste rather than an ingredient that demands the spotlight for its own sake. For the product developers and food scientists in our team, used to working with raw potential, mycelium was a gift. For the chefs and creatives, it was a challenge.

The rich outcome of this lab makes me proud. It was a real pleasure working with such a diverse and talented team.

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About mycelium

Thinking beyond the meat analogue, how can mycelium create a new category in food applications?

Mycelium, the root network of fungi, is often used to create meat alternatives like plant-based "chicken fillet". While these products help build a more sustainable food system, they still cling to the idea of imitating meat. But let's be real – a mycelium "chicken fillet" will never be exactly like a chicken fillet from, well, a chicken. And it doesn't need to be. Mycelium has more potential than just playing copycat.

And that's exactly what this Low Food Lab set out to explore. The participants, who come from a variety of backgrounds, dived into the world of mycelium, pushing past the meat substitute mindset to discover what else this powerhouse ingredient can do. Collaborating with agri-food company Cargill and start-up ENOUGH, which is supported by the CBE-JU Plenitude project: 838104, they got hands-on with ABUNDA® mycoprotein, ENOUGH's mycelium-based protein. Being creative in their experiments, adventurous in trying new techniques and bold in their recipe development, they worked to put mycelium in the spotlight – not as a meat imitation, but as a groundbreaking ingredient in its own right. The results? Mouthwatering mycelium-based snacks and dishes that prove this ingredient deserves its own category.
With this in mind, the research question for this lab is: *thinking beyond the meat analogue, how can mycelium create a new category in food applications?*

DEFINITIONS

Mycelium: The general scientific term for the root-like structure of fungi, composed of branching thread-like hyphae.

Mycoprotein: The common term used when mycelium is manufactured into a food ingredient.

ABUNDA® mycoprotein: A specific type of mycoprotein developed by ENOUGH, made from fermented mycelium.

Michael Kilkie, Tessa van der Geer

The qualities of mycelium

Mycelium consists of a mass of branching, thread-like hyphae. Its advantages, a powerful combination of sustainability, nutrition and health benefits, mean that it could potentially be a game-changing ingredient. When used as an ingredient in food, mycelium is called mycoprotein.

First off, mycoprotein is a true sustainability hero. It plays a vital role in breaking down organic material, enriching soil health and forming symbiotic relationships with 92% of plant families. It's even a major food source for insects and other invertebrates. It grows very rapidly (it doubles in mass every 5 hours), needs a bare minimum of land and water while leaving a very low carbon footprint. In the construction industry, mycelium is already used in insulation materials, for example. In the food field, however, the potential has not yet been sufficiently exploited beyond the meat analogue, although fungi-based food production generates up to 40-52% less pollution compared to livestock farming. [1]

But mycoprotein isn't just good for the planet – it's great for the body too. Some types of mycoprotein have already been proven safe to consume and approval has been granted to use it in food products. Naturally rich in protein and fibre but low in sugars and fats, mycoprotein is both nutritious and low in calories. It can increase satiety and reduce energy intake. Additionally, it has been linked to improved lipid levels, lower cholesterol and improved markers of glycemia and insulinemia. Mycoprotein may even stimulate muscle protein synthesis.

ABUNDA® Mycoprotein

Scottish start-up ENOUGH, based in Sas van Gent, has created a sustainable protein called ABUNDA® mycoprotein using mycelium fermented with natural sugars from grains. ABUNDA® mycoprotein consists of 75% water and 25% mycelium. It contains all 9 essential amino acids. ABUNDA® uses 99% less water, 98% less land and 95% less CO2 than the production of red meat. Its unique texture – firm, fibrous and juicy – resembles meat while its flavour ranges from neutral to slightly umami; it has a light beige, flaky appearance. Freezing helps align the fibres. Its odour is neutral, slightly yeasty. It is a "wet protein" with a consistency similar to chicken mince, offering a clean taste. An advantage is that it is not hyper-processed, having only a short ingredient list. It is an affordable ingredient as well: it is similar to the costs of meat.

Mycoprotein - raw material

PARAMETER	PER 100 G
Energy	85.6 kcal
Fat	1 g
Carbohydrate	8 g
Protein	13 g
Fibre	6 g
Sodium	<0.1 mg
Cholesterol	Not detected

1. Meat Substitute Development from Fungal Protein (Aspergillus oryzae) - Olasky Gamarra-Castillo, Nicolás Echeverry-Montaña, Angelis Marbello-Santrich, María Hernández-Carrión and Silvia Restrepo. https://www.mdpi.com/2304-8158/11/19/2940

Impact analysis by Jonah Koppe, food-system analyst at Flevo Campus

The Low Food Lab brings together chefs, food scientists and innovators to develop novel uses for mycoprotein and expand its role in the food system. I would like to provide an impact analysis of these innovations that assesses their potential effects on sustainability and nutrition from a broader, food-systems perspective.

While mycoprotein's value as a sustainable meat substitute is well established, this lab seeks to push its boundaries further. Innovations that replace high-footprint ingredients or processed foods can maximize environmental and nutritional benefits. By integrating mycoprotein into multifarious applications, we're hoping that new pathways for sustainable food systems will emerge. However, when novelty is prioritized over measurable benefits, we need careful evaluation to ensure meaningful impact.

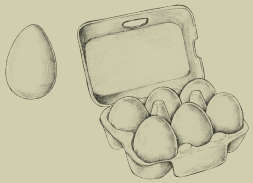
A summary of the overall impact analysis is presented in a small textbox next to the recipes. The metrics displayed (on the right) serve as a guideline for understanding the potential benefits of these innovations. However, it is important to recognize that these outcomes are highly context-dependent and influenced by factors such as ingredient sourcing, production methods and regional differences. Rather than making direct one-on-one comparisons with existing products, the focus will be on what mycoprotein replaces or contributes with each innovation. This approach helps highlight its potential role in shaping more sustainable food systems.

This perspective acknowledges the complexity of food-production systems, where location, resource availability and processing techniques all play critical roles. While the listed metrics do not fully capture the entire food-system landscape and are not the sole criteria for evaluating innovations, they provide valuable insights and serve as a guide in assessing mycoprotein's impact.

Metrics context

- CO2 Equivalent (CO2e): a measure of total greenhouse gas (GHG) emissions, encompassing farming practices, livestock digestion and supply chain processes.
- Water Usage: encompasses blue (surface/groundwater), green (rainwater) and grey water (pollution dilution).
- Land Usage: evaluates the area required for production, including direct crop cultivation and grazing land.
- Water-Weighted Scarcity: assesses water consumption in relation to regional availability, emphasizing the importance of minimizing water use in arid and drought-prone areas.
- Eutrophication Risk: focuses on nutrient runoff, such as nitrogen and phosphorus, which leads to harmful ecological effects like algal blooms and oxygen depletion.
- Nutritional Value: reviews the nutritional value, focussing on the macronutrients in a product or ingredient.

Mycoprotein compared to other protein sources

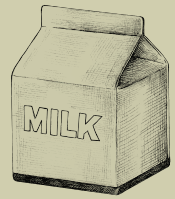


EGGS

PER 1 KG
6.8 m2
830 L
4.4 kg CO2e
PER 100 GRAM
13 g protein
0 g fibre
3.3 g sat fat
7.7 g un sat fat

MYCOPROTEIN

PER 1 KG
1.2 m2
123 L
2.4 kg CO2e
PER 100 GRAM
13 g protein
7 g fibre
0.5 g sat fat
1.5 g unsat fat



COW'S MILK

PER 1 KG
4.07 m2
309 L
3.7 kg CO2e
PER 100 GRAM
3.4 gprotein
0 g fibre
0.6 g sat fat
0.4 g un sat fat

Tessa van der Geer

To explore its potential, Tessa experimented with different cooking techniques, including frying and emulsifying.

After an early career in finance, Tessa switched gears and attended cooking school in Ireland. Now, three years later, she works with food every day – not just in the kitchen but also as a food transition consultant; her roles include Head of Labs for Low Food. She really learned how to cook as chef de parti at Foer Amsterdam

The study

ABUNDA® mycoprotein reminded Tessa of a wet cracker, both in taste and texture, at first. To explore its potential, she experimented with different cooking techniques, including frying and emulsifying. She discovered that emulsifying ABUNDA® mycoprotein with water created a binding agent similar to egg, sparking an idea inspired by the Japanese flavours other participants were exploring. Her first test showed promise, so she analysed traditional okonomiyaki recipes.

Initially, she used only emulsified ABUNDA® as an egg alternative, but in a second attempt, she added small ABUNDA® mycoprotein chunks for texture and to increase its presence in the dish. With a few refinements, she arrived at the final recipe.

The results

Tessa believes the final dish closely resembles traditional okonomiyaki, with toppings and sauce enhancing the experience. She was surprised by how well ABUNDA® mycoprotein emulsified with water, but even more so by its impressive binding properties. Both in cooking and texture, the emulsion proved to be a perfect egg replacement.

Vegan ABUNDA® Okonomiyaki

RECIPE BY TESSA VAN DER GEER

SERVES 4 TO 6 PEOPLE AS A SNACK / STARTER.

EQUIPMENT

- Magimix (food processor)
- frying pan
- mixing bowl
- whisk

INGREDIENTS

ABUNDA® binding mixture

- 150 g ABUNDA® mycoprotein
- 150 g water

Okonomiyaki dough

- 150 g pointed cabbage
- 2 red chilli peppers
- 70 g ABUNDA® mycoprotein flakes
- 100 g flour
- 1 tsp miso
- 1 tbsp panko (or breadcrumbs)
- pinch of baking powder
- pinch of salt
- 1 tsp of soy sauce
- 200 g dashi stock
- 2 tbsp sunflower oil (or any oil)

Okonomiyaki sauce

- 4 tbsp ketchup
- ½ tbsp Worcestershire sauce
- ½ tsp mustard
- 2 tbsp mirin (or sushi vinegar)
- 1 tbsp soy sauce

Toppings (of choice)

- (Kewpie) mayo
- spring onion
- nori
- sushi ginger
- furikake (can be vegan)
- bottarga (not vegan)

METHOD

ABUNDA® binding mixture

1. Put 150 g water and 150 g ABUNDA® mycoprotein in the food processor.
2. Mix until emulsified.

Okonomiyaki dough

1. Take out the heart of the cabbage.
2. Thinly chop the cabbage (shred).
3. Take out the seeds of the red chilli.
4. Chop in tiny cubes.
5. Heat the water, make dashi stock
6. Mix flour, baking powder, panko, dashi stock, 180 g ABUNDA® mycoprotein binding mixture, 50 g ABUNDA® mycoprotein chunks, salt and soy sauce.
7. Whisk.
8. Add shredded cabbage and the red chilli cubes.
9. Mix well (if necessary add more ABUNDA® mycoprotein binding mix).

Fry okonomiyaki

1. Heat pan with tbs of sunflower oil (or any other oil, sesame is also tasty).
2. Add two tbsp of okonomiyaki mixture to the pan.
3. Fry the okonomiyaki (make sure the bottom is nicely fried before turning).
4. Turn and fry until golden brown.

Okonomiyaki sauce

Mix all ingredients well.

Cooking tips

- Make sure your pan is hot!
- Serve with toppings of choice.

JONAH'S ANALYSIS

"Eggs play a significant role in okonomiyaki. Replacing them with mycoprotein in the future without compromising the dish could be beneficial in terms of greenhouse gas emissions and the use of water and land. Egg production contributes significantly to GHG emissions, with estimates of around 4.4 kg CO_2e per kg of eggs, so replacing it with mycoprotein could lead to a significant reduction. Egg production requires land for feed crops and water for poultry farming, whereas mycoprotein cultivation has a smaller land and water footprint. Chickens need about 4,000 litres of water per kg of eggs, while mycoprotein uses significantly less due to efficient fermentation techniques."

Emile Samson

Emile Samson works in Belgium as a plant-based fermentation specialist focusing on cross-over fermentation for plant-based and hybrid charcuterie. He also co-founded the European Miso Institute, a non-profit organisation promoting miso and other fermented umami products as key elements in the protein transition.

The study

Emile wanted to uncover the versatility of mycoprotein and create applications that are easily customizable. Given his background, he naturally started by making a miso with mycoprotein. He then developed two sandwich spreads based on that miso, leveraging its long fibres for texture. He also experimented with a dried, smoked and mould-fermented mycoprotein block "lardo" which he designed for charcuterie boards. Since those creations required extensive preparation, he also wanted to develop something that is both doable for home cooks and scalable for industry, which is why he also developed a protein-rich, dried mycoprotein-based jerky snack.

The first attempt at an aged mycoprotein "lardo", overgrown with koji, had a strong visual impact but some issues. The texture was slightly pasty and the direct application of koji didn't achieve the desired effect – the flavour was still quite mild. However, the neutral flavour of the mycoprotein provided an excellent base for bold seasonings, offering many creative possibilities. By shifting the focus towards brining, smoking and incorporating more herbs, Emile improved the final version significantly and achieved a much better result.

The results

Both the jerky and "lardo" blocks can easily be adapted with herbs and spices to fit a range of flavour profiles and cuisines. Emile thought the structural differences that were produced by various cutting techniques were fascinating. A range of different aspects can be achieved with miso, depending on the aging conditions. So, as he was concerned about the aging time of naturally fermented miso, Emile aged a miso at 60°C to create a "Maillard miso" with a very chocolatey aroma. Excited by the flavours of the naturally fermented miso after only a few weeks of fermentation, he used it in familiar, crowd-pleasing sandwich spreads inspired by chicken curry and tuna salads. To amp up the mycoprotein content, he made a mayonnaise stabilized by mycoprotein as well.

Mycolardo

RECIPE BY EMILE SAMSON

EQUIPMENT

- smoking oven
- 1000 ml storage container
- food dehydrator
- vacuum bag + sealer

INGREDIENTS

- 500 g block of ABUNDA® mycoprotein
- brine
  - 500 g water
  - 15 g salt
  - optional: 2 g MSG
  - 1 tsp of peppercorns
- hickory smoke sawdust (other wood types are also ok)
- 3 tbsp Herbs de Provence
- 1 tbsp cracked black pepper

METHOD

1. Dissolve the salt and MSG in the brine, then add the ABUNDA® mycoprotein & black pepper.
2. Steep the ABUNDA® mycoprotein in brine for at least 24h in the fridge.
3. Prepare a smoking chamber with some hickory wood flakes (smoke sawdust).
4. Smoke the ABUNDA® mycoprotein for at least 15 minutes.
5. Once done, roll the smoked ABUNDA® mycoprotein into the herb and black pepper mixture.
6. Dry in an oven on low or in a dehydrator at 45 °C for 5 hours.
7. Store in a vacuum bag and slice thin when ready to serve.

Cooking tips

- Slice the ABUNDA® mycoprotein while semi-frozen to get clean-cut blocks.
- If you do not have access to a smoker, consider adding liquid smoke or smoked salt to the brine.

JONAH'S ANALYSIS

"Pig farming is a significant contributor to CO_2e, especially methane (CH_4) and nitrous oxide (N_2O), which have high global warming potential. Lard is high in saturated fat (~39%) and contains dietary cholesterol, which can contribute to heart disease and high LDL ("bad") cholesterol levels. Mycoprotein offers a far more sustainable and nutritious replacement."

Mycojerky

RECIPE BY EMILE SAMSON

10 SNACK SERVINGS

EQUIPMENT

- food dehydrator or oven set to low
- bowl
- scale (preferably 0.1g accuracy)
- vacuum device
- vacuum bag (or marinate in a Tupperware tub)

INGREDIENTS

- 500 g ABUNDA® mycoprotein
- 150 ml ketjap manis sweet Indonesian soy sauce
- 15 g sesame oil
- 80 g black vinegar
- 2 g black pepper
- 4 tsp smoked paprika
- 1 tsp smoked salt
- 4 tsp crushed Sichuan pepper
- 2 tsp five spice

METHOD

1. Take the ABUNDA® mycoprotein out of the freezer but do not let it thaw completely. While it is still semi-frozen, slice off thin strips from the block of mycoprotein.
2. Pat the now defrosted slices of mycoprotein with paper towels to remove the excess moisture.

3. Mix all the ingredients for the marinade in a bowl.
4. Mix the ABUNDA® mycoprotein with the marinade; optionally. vacuum it for faster absorption of the marinade.
5. Place the marinated ABUNDA® mycoprotein in the fridge at least overnight.
6. Remove the excess marinade and place the slices, evenly spaced, on a wire rack or pan with baking paper.
7. Dehydrate the mycoprotein at 65°C for around four hours or until fully dehydrated (flip at least once to dry the bottom too), then place in an airtight container.
8. Enjoy the mycoprotein jerky as a flavourful and convenient protein packed snack!

Cooking tips

- Slicing the ABUNDA® mycoprotein thinly while thawed will likely cause lots of tearing and it is hard to get an extremely thin slice, while a block straight out of the freezer might be too hard on your knife, so the trick to getting nice slices is to thaw it slightly and try to find the right moment to create perfectly even, thin slices.
- I went for an Asian flavour profile because that's what I enjoy most, but the marinade can be customized to any flavour you want!
- If the jerky is too tough for you, consider adding more oil to the marinade to get a more supple texture.

JONAH'S ANALYSIS

"Mycoprotein offers a far more sustainable alternative to beef. Beef production generates around 129 kg CO_2e per kg, while mycoprotein emits significantly less due to its efficient fermentation process. Raising cattle also requires vast amounts of land, contributing to deforestation, whereas mycoprotein is grown in tanks, using 95% less land. Water consumption is another major factor: producing 1 kg of beef requires 19,000 litres, while mycoprotein uses far less, making it a more water-efficient option. Additionally, industrial beef farming relies on antibiotics, which contributes to antibiotic resistance, and produces manure runoff that pollutes water sources. Mycoprotein, by contrast, is free of antibiotics and generates minimal waste, reducing environmental risks."

Mycomiso

RECIPE BY EMILE SAMSON

EQUIPMENT

- steam oven or pot + steam basket
- tray
- small sieve
- tea cloth
- fermentation incubator
- mason jar (1 l)
- optional: blackening incubator

INGREDIENTS

- 500 g steel cut oats (or other grains)
- 500 g ABUNDA® mycoprotein
- 1 tsp koji-kin
- 80 g salt (8%)

METHOD

1. Koji preparation

- Soak the oats for 2 hours (or longer if using other grains).
- Drain, place in a cloth and steam for 30 minutes.
- Spread the steamed oats over a tray and stir gently to cool.
- Once below 40°C, sprinkle the koji spores onto the oats through a small sieve.
- Prepare an incubator at 30°C and 75% RH.
- Cover the oats with a damp towel and place in incubator.
- After 24h, check the temperature and stir the oats lightly.
- If needed, repeat this step (stirring promotes growth and evaporation).
- After 44 hours or whenever the oats are fully covered with koji, cool down or use directly.

2. Miso preparation

- Weigh 450 g of oat koji and 450 g of ABUNDA® mycoprotein.
- Weigh 8% of salt (72 grams).
- Mix the koji, ABUNDA® mycoprotein and salt (reserving ±10 g) into a paste with a meat mincer or mixer.
- Place the miso in a clean jar ensuring there are no air bubbles.
- Clean the edges of the jar and sprinkle the remaining salt on the surface.
- Close the jar and incubate for at least 12 weeks at room temperature or 1 week at 55-60°C.

Cooking tips

- Use whole or steel cut oats for the koji as olled oats release too much starch and will become mushy, leading to poor koji growth.
- If you are a beginner at making koji, I recommend using barley or rice instead.
- Choose your incubation method according to the intended application:
  - "Mailliard miso" made at 55-60°C will have a less nuanced flavour and will be rich in caramelised, chocolatey flavours.
  - The naturally fermented miso takes more time but produces a more vibrant aromatic flavour profile.

Myco-curry Sandwich Spread

RECIPE BY EMILE SAMSON

10 SERVINGS

EQUIPMENT

- bowl
- scale
- forks
- spoons
- storage container

INGREDIENTS

- Mycomiso
- Mycomayo
  - 50 g mycomiso
  - 10 g mustard
  - 20 ml vinegar
  - 150 ml sunflower oil
- A few cracked black peppercorns
- ½ tablespoon curry powder
- 3 tbsp mycomiso
- 1 small tin of chickpeas (150 g)
- 3 tbsp mayonnaise
- 1 tsp mustard
- 4 tsp piccalilli
- 1 small apple
- 1 tbsp creme fraiche

METHOD

1. First make the mycomayo by placing the mycomiso (or just mycoprotein) in a tall beaker with the mustard and vinegar and blending until smooth.
2. Slowly start adding in the sunflower oil to create a stable emulsion.
3. In a bowl, shred the mycomiso using two forks to create a stringy texture.
4. Drain the chickpeas and mash them into smaller chunks to give texture to the salad.
5. Chop the apples into small cubes, then mix all the ingredients.
6. Adjust seasoning to your taste and enjoy!

Cooking tips

- If you haven't made mycomiso, it's okay to just use the mycoprotein directly and adjust the seasoning by adding a store-bought miso or other taste-makers.
- Also feel free to use this as a base and to play around with different flavour profiles, e.g. by removing the curry powder and adding seaweed for more of a tuna salad vibe.

Ayane Kogure

Ayane works as a food designer and chef in various fields, developing recipes or designing menus for the catering industry, doing food-styling work for ceramic companies such as KINTO and magazines. As a founder & owner-chef of HYSSOP (private dining), she organizes, plans and executes farm-to-table style culinary gatherings.

The study

Ayane thought this lab was an interesting opportunity to explore the possibilities of mycoprotein using her background and knowledge from Japan. Her initial research idea was creating “Mycelium Tofu” in sesame tofu style. She was also trying to create a new seasoning “Mycelium Hishio”, but found it a little bit challenging to do it the koji way without the original ABUNDA® mycoprotein spore. She eventually focused on increasing the percentage of mycoprotein in tofu and how to eat this mycoprotein tofu in a tasty way.

The results

Ayane is very happy with the final results of the product. She tried to increase the percentage of mycoprotein up to 60% (8% protein), but did not like the taste or texture. The final product consists of 33.3% mycoprotein (tripled compared to the initial experiment), which has a nice balance of taste and texture. As she increased the percentage of mycoprotein in tofu, she needed almost half the amount of kuzu to set the tofu. The bitterness of Mycoprotein in tofu surprised her, but this disappeared after it had been fried. The tofu worked very well, both in savoury and sweet dishes, after frying. It is still possible to increase the percentage of mycoprotein in the tofu, but the more mycoprotein in the tofu, the more bitterness you will taste.

Mycelium Tofu

RECIPE BY AYANE KOGURE

EQUIPMENT

- blender
- pan
- whisk
- spatula
- fine Chinois strainer
- metal lining tray

INGREDIENTS

- 150 g ABUNDA® mycoprotein
- 270 ml kombu dashi
- 30 g kuzu
- pinch of salt

METHOD

1. If you make your own kombu dashi, soak 4-5 cm kombu in a pan with water and leave for a few hours.
2. Whisk kuzu in a bowl with the kombu dashi until completely dissolved.
3. Blitz the mycoprotein with the kuzu-dashi and a pinch of salt.
4. Transfer the mycoprotein mixture to a pan through a fine Chinois strainer to make it smooth.
5. Cook over medium heat, stirring constantly. Once it starts to thicken, you can slightly lower the heat, and keep cooking for 10-15 mins.
6. It is ready once you can drop some mixture from a spatula and it keeps the shape for a second or two. Transfer the mixture to a wet metal lining tray or a container with cling film. Cover the surface with cling film and leave to set.

Cooking tips

- It is important to keep stirring the mixture constantly and evenly while cooking until the mixture gets thick and set.
- Once it is set, you can serve with some seasoning such as hishio, wasabi-shoyu, or coat the mycoprotein tofu with potato starch and fry until golden. You can serve the fried mycoprotein tofu both in savoury (with some sauces) or sweet (coating with sugar etc...) ways.

JONAH'S ANALYSIS

"Sesame tofu is traditionally made from sesame paste, kuzu and water. The production of sesame paste has a high carbon footprint, ranging from 7 to 9 kg CO_2e per kilogram of sesame paste. Additionally, conventional sesame farming practices, which often rely on the use of pesticides and fertilizers, contribute to eutrophication. Using mycoprotein instead reveals potential benefits, reducing both on CO_2e and eutrophication risk"


Mycelium Hishio
20 / 11 / 2024

Annemarijn Verboom

Annemarijn Verboom is a visual designer and founder of Atelier Annemarijn. Nature, food and interior design are her major passions, which she combined during the Low Food Lab. During her time at Utrecht's HKU University of the Arts, she worked on many projects related to sustainability, circularity and nature.

The study

Annemarijn has seen many bio-artists creating mesmerising and innovative things out of bio-based materials and was inspired by their craft. Mycelium is a rapidly emerging trend in the design industry, and she was curious to understand why.

Annemarijn started growing mycelium at home, using broken mushrooms that she foraged in the woods. She thought it was fascinating to see how the mycelium grows and the different stages it goes through. Annemarijn also experimented with different bases, such as turmeric and beetroot. Next, she began creating new materials using ABUNDA® mycoprotein. She made paper by pressing it and crafted leather

by drying it. She even grew mycelium on top of the ABUNDA® mycoprotein. She also used ABUNDA® mycoprotein to make stamps to create graphic prints. Next, she started growing mycelium by mixing it with an agricultural byproduct, which led to the creation of a painting and a candle holder.

The results

The colours and textures of ABUNDA® mycoprotein and mycelium perfectly align with the current beige interior trend. After creating a painting, a bowl, and a candle holder, she combined different forms and techniques to design a mushroom-shaped lamp made from actual mushrooms. She mixed ABUNDA® with glue and dried it, then grew the lamp stand using a mycelium and wood mix, incorporating an electrical cable inside.

Mushroom Lamp
made from actual mushrooms

RECIPE BY ANNEMARIJN VERBOOM

The lampshade

EQUIPMENT

- oven
- tea towel
- pestle
- sieve
- spoon
- 2 bowls (one for mixing, one as a mould)
- cling film

INGREDIENTS

- 1 kg ABUNDA® mycoprotein
- 8 tbsp wallpaper glue (or another very strong and transparent glue)

METHOD

1. Defrost the ABUNDA® mycoprotein.
2. Place the ABUNDA® mycoprotein in a sieve and use a pestle to press out as much water as possible.
3. Transfer the ABUNDA® mycoprotein to a tea towel and squeeze out any remaining excess water.
4. Mix the drained ABUNDA® mycoprotein with 8 heaping tablespoons of wallpaper glue.
5. Line a bowl with cling film.
6. Evenly spread the ABUNDA® mycoprotein mixture over the bowl, shaping it into a smooth layer.

7. Preheat the oven to 60°C.
8. Place the bowl on a baking sheet and let it dry in the oven until completely hardened.
9. Keep an eye on the oven while drying. The mixture can be slippery, and you may need to adjust it before it sets.
10. Once fully dry, carefully remove the cling film and the inner bowl. Your ABUNDA® mycoprotein lampshade is now ready!

The lamp base

EQUIPMENT

- ethanol (for sterilization)
- cling film
- growth moulds
- electrical cable
- tube
- lamp
- wire
- lamp socket
- plug
- rubbish bag

INGREDIENTS

- 30 g flour
- Grow kit from Grown.bio (Grown with Ecovative's technology)

METHOD

1. Assemble a working electrical cord by connecting the cable, plug and lamp socket.
2. Cut the tube to the desired height for your lamp base.
3. Insert the lamp socket into the tube (trim the tube further if needed) and thread the cable through it. Set this aside for now.
4. Follow the instructions from the Grow-It-Yourself kit. Grow the mycelium into a cylindrical shape, placing the tube with the electrical cord in the centre.
5. Continue following the steps of the Grow-It-Yourself kit. Important: when drying the mycelium, make sure to keep the electrical cord out of the oven.
6. As a final step, create a mount for the lampshade using wire. Now, simply screw in the light bulb, and your lamp is ready to use!

Wendy Luong

Wendy Luong is a food scientist and consultant specialized in strategic product development for plant-based, healthier, and future-proof foods. She advises food businesses on innovation strategies, market trends and how to create impactful products.

The study

Wendy initially wanted to explore mycoprotein's functionality as an egg and fat replacement. Early in her research, she found that it worked well for both, but she was surprised to see it performed better in gluten-free cakes than in wheat-based cakes. This led her to focus more on gluten-free applications.

In the first phase, she tested functionality as an egg and fat replacement while attempting to add as much mycoprotein as possible. She also researched different types of flours and starches to study the interactions. In the second phase, she became more creative, combining her findings to develop a multi-component product, pushing the limits to incorporate the highest possible amount of mycoprotein while maintaining good texture and flavour.

The results

Wendy is excited by the results, especially how well mycoprotein functions as both an egg and fat replacement. She believes that incorporating mycoprotein in bakery products is an efficient way to use larger volumes of mycoprotein, as it is a highly scalable application with strong potential for future growth. She was surprised that mycoprotein performed better in gluten-free cakes than in wheat-based ones, creating a better texture and structure without gluten. She sees opportunities for further research in optimizing mycoprotein texture for various gluten-free bakery products and enhancing it through techniques like whipping or fermentation. Studying its interaction with fibres such as psyllium or inulin could improve texture and shelf life. Wendy is also interested in how mycoprotein can replace sugar's volume in fat-free and sugar-free cakes to create healthier, scalable baked goods. Compared to a conventional chocolate cupcake, her mycoprotein cupcake is 37% lower in Kcal, 83% lower in fat, 120% higher in protein and 135% higher in fibres.

Chocolate Abundance - Mycelium as egg, fat and gluten replacement

RECIPE BY WENDY LUONG

FOR 6 CUPCAKES

EQUIPMENT

- high-shear blender
- oven
- muffin tins
- drying oven

INGREDIENTS

Component 1: chocolate cake

- 30 g rice flour
- 18 g oat flour
- 18 g potato starch
- 15 g tapioca starch
- 12 g quinoa flour
- 24 g cocoa powder
- 3.6 g baking powder
- 1.2 g salt
- 120 g ABUNDA® mycoprotein
- 72 g dark brown sugar
- 210 g soy milk
- 6 g apple cider vinegar

Component 2: chocolate frosting

- 90 g ABUNDA® mycoprotein
- 50 g powdered sugar
- 7.5 g cocoa powder
- 30 g soy milk
- 0.9 g salt

Component 3: sweet and savoury crunch

- 120 g ABUNDA® mycoprotein (dried will be around 30 g)
- 15 g agave syrup (should be half of the final dried mass)
- Pinch of salt
- Few drops of liquid smoke

METHOD

Component 1: chocolate cake

1. Preheat the oven to 200°C.
2. Blend the ABUNDA® mycoprotein with a high-shear blender until smooth.
3. In a small bowl, combine the soy milk and apple cider vinegar, stir and leave for 15 minutes to curdle (creates vegan buttermilk).
4. In a large bowl, mix the rice flour, oat flour, potato starch, tapioca starch, quinoa flour, cocoa powder, baking powder and salt. Sieve the mixture to remove lumps.
5. Add the dark brown sugar to the blended micoprotein, then pour in the soy milk-vinegar mixture and mix well.
6. Gradually add the dry ingredients into the wet mixture, stirring constantly with a spatula until a smooth batter forms. Do not overmix.
7. Divide the batter evenly into 6 greased muffin tins.
8. Bake at 200°C for 5 minutes, then reduce the temperature to 180°C and bake for another 15 minutes, or until a skewer inserted in the centre comes out clean.
9. Let the cakes cool completely on a wire rack before adding the topping.

Component 2: chocolate frosting

1. Blend the ABUNDA® mycoprotein with a high-shear blender until smooth and creamy.
2. Add the powdered sugar, cocoa powder, soy milk and salt to the ABUNDA® mycoprotein.
3. Blend again until creamy and smooth. Adjust the soy milk if needed to reach a spreadable/pipeable consistency.

Component 3: sweet and savoury crunch

1. Spread the ABUNDA® mycoprotein evenly on a drying rack and dry at 30°C for 8 hours until fully dry.
2. Preheat the oven to 160°C.
3. Weigh the dried ABUNDA® and add half of its weight in agave syrup.
4. Add a pinch of salt and a few drops of liquid smoke, then mix well to coat evenly.
5. Spread the coated ABUNDA® mycoprotein on a baking tray.
6. Bake at 160°C for 7 minutes until crispy, keeping a close eye on it to prevent burning.
7. Let the crunch cool completely. They will crisp up further as they cool.

Cooking tips

- For the cakes: the smoother the ABUNDA® mycoprotein, the better the final texture of the cake. Mix the wet and dry ingredients until just combined to avoid a dense texture.
- For the frosting: use a high shear blender to create a smooth texture and adjust the liquid as needed.
- For the crunch: a thin layer of ABUNDA® mycoprotein dries more evenly and crisps better during baking.

JONAH'S ANALYSIS

"Traditional muffins rely on butter or oil for moisture and texture, which leads to a high saturated fat and calorie content. Mycoprotein is rich in fibre, not in fat, improving digestive health and satiety, which is not typically found in butter or oil. The added value of mycoprotein as a replacement for solely plant-based oils like olive or sunflower oil is significant, as both oils come from highly resource-intensive crops. Olive and sunflower farming require vast amounts of water and land, contributing to deforestation and habitat loss. Their large-scale cultivation also leads to high CO_2 emissions and increases the risk of eutrophication due to fertilizer runoff. By contrast, mycoprotein is produced through fermentation, a far more efficient process with a lower environmental footprint, requiring significantly less water, land and energy while avoiding the pollution associated with large-scale oil crop farming."

Muffin experiments
by Wendy Luong

Eyad Khamis

While the textures showed promise, Eyad saw room for further refinement.

Eyad Khamis is a cook and founder of Mama's Keuken, a catering company in Amsterdam that brings the warmth of home-cooked meals to a wider audience. With a deep appreciation of traditional flavours, he continuously explores new ways to innovate while staying true to the essence of homemade cooking.

The study

The versatility of mycoprotein sparked countless ideas for Eyad, ranging from traditional Syrian snacks like falafel, hummus and kibbeh to more complex creations like mascarpone alternatives, meringues and marshmallows. In the end, he decided to concentrate on hummus, falafel, kibbeh and nutrient-dense date and nut bites – beloved staples that could benefit from a nutritional boost through mycoprotein. His approach was hands-on, relying on extensive trial and error rather than rigid research methods. By testing continuously, he explored how mycoprotein could enhance texture, nutrition and overall flavour, refining his process with each iteration.

The results

Eyad was pleased with the results, the flavours were good, and while the textures showed promise, he saw room for further refinement. One of the biggest surprises to him was how easy mycoprotein was to work with once he understood how to handle it properly. Looking ahead, he sees exciting opportunities in making mycoprotein more accessible to home cooks and professional chefs alike. Exploring different formats – such as powdered or liquid mycoprotein – could open up even more possibilities for incorporating this unique ingredient into everyday cooking.

Mycelium-Packed Falafel

RECIPE BY EYAD KHAMIS

FOR 35-40 PATTIES

EQUIPMENT

- meat mincer (3 mm mincer disc recommended) or a food processor
- mixing bowl
- measuring spoons
- deep fryer or heavy-bottomed pan

INGREDIENTS

- 350 g dried chickpeas
- 350 g ABUNDA® mycoprotein
- 1 tbsp salt
- ½ tsp white pepper
- ½ tbsp cumin powder
- 1 tbsp coriander powder
- ½ tbsp garlic powder
- 1 tbsp baking powder
- 100 g chopped white onion
- 3 cloves of garlic
- fresh parsley & coriander (to taste)
- 1 l frying oil (peanut oil recommended)

METHOD

1. Rinse and soak dried chickpeas in 2 litres of water overnight (12+ hours) until they double in size. Drain and rinse well.
2. Cut ABUNDA® mycoprotein into small pieces. Combine with chickpeas, onion, garlic, parsley and coriander, then mince in a meat mincer (or pulse in a food processor) until coarse.
3. Mix the spices: add salt, white pepper, cumin, coriander and garlic powder. Mix thoroughly by hand for 7-10 minutes. Leave to rest in the fridge.
4. Mix in the baking powder 10 minutes before frying for a lighter texture. Add cold water if the dough is stiff as it should glide off the scoop or the spoons while dropping in the oil.
5. Eat oil to 170°C. Shape falafel using a scoop or spoons and fry for 3.5-4.5 minutes until golden brown, turn the falafel halfway.
6. Drain on paper towels and serve with hummus or tahini sauce, topped with sumac.

Cooking tips

- For a chunkier texture, use a meat mincer. If using a food processor, pulse to avoid over-processing.
- When the falafel floats to the surface, they are almost ready. It is up to you to leave them longer for more crunch. Try different frying times, so you can decide when they are perfect to your taste.
- Freeze the mix for up to 3 months, but only add spices & baking powder after thawing but before frying.
- Serve with fresh pita, hummus and pickled veggies

Mycelium-Packed Hummus

RECIPE BY EYAD KHAMIS

FOR 6-8 SERVINGS

EQUIPMENT

- food processor
- mixing bowl
- measuring spoons

INGREDIENTS

- 250 g ABUNDA® mycoprotein
- 300 g aquafaba (chickpea water)
- 2 ice cubes
- 50 g cooked chickpeas (canned)
- 200 g tahini
- 1 large clove garlic, minced
- 100 ml lemon juice
- 2 tbsp salad oil
- 1 ½ tsp salt
- 1 tsp cumin
- virgin olive oil (for topping)

METHOD

1. Blend the base: on a food processor, combine chickpeas, salt, cumin, garlic, aquafaba and ice cubes. Blend for 5-7 minutes until smooth.
2. Emulsify: while blending, gradually add oil, then lemon juice, followed by tahini.
3. For a smoother texture, blend for 1-2 extra minutes until silky.
4. Spread onto a plate, top with chickpeas, cumin, cayenne pepper and a generous drizzle of olive oil.

Cooking tips

- Use chilled chickpeas & aquafaba for an ultra-creamy texture.
- Adjust to taste: add extra lemon juice for a tangier flavour.
- Garnish options: stir in chopped parsley for extra freshness.

JONAH'S ANALYSIS

The use of mycoprotein in falafel improves the amino acid profile and completes the proteins. Chickpeas are often grown in water arid regions and therefore score high on water weighted scarcity. A reduction on chickpeas cultivation can improve water weighted scarcity.

Mycelium-Packed Kibbeh

RECIPE BY EYAD KHAMIS

FOR 20 KIBBEH BALLS

EQUIPMENT

- meat mincer (3 mm mincing disc recommended) or a food processor
- mixing bowl
- measuring spoons
- deep fryer or heavy-bottomed pan

INGREDIENTS

For the shell:

- 250 g fine bulgur
- 250 g ABUNDA® mycoprotein
- ½ tbsp salt
- ½ tsp white pepper
- ½ tsp black pepper
- ½ tsp cumin powder
- ½ tsp coriander powder
- ½ tsp garlic powder
- ½ tsp cayenne pepper
- 75 g chopped white onion
- 1 l frying oil (peanut oil recommended)

For the filling:

- 400 g finely diced chestnut mushrooms
- 25 g ABUNDA® mycoprotein
- 100 g chopped white onion
- 50-75 g chopped walnuts (optional)
- 1 ½ tsp salt
- ½ tsp 7 spices mix
- ½ tsp black pepper
- ¼ tsp cinnamon powder
- ¼ tsp ginger powder
- 3 tbsp frying oil

METHOD

1. Prepare the shell: in a strainer, rinse the bulgur thoroughly with cold water, then soak in lukewarm water for 10 minutes, then drain well. Mince the ABUNDA® mycoprotein, bulgur and onion then mix with the spices. Knead until a firm dough forms.
2. Make the filling: in a pan, heat oil and sauté onions until translucent. Add mushrooms, ABUNDA® mycoprotein, walnuts (if using) and spices. Cook until fragrant and moisture is reduced.
3. Take a small portion of the shell mixture around 40g, form a ball: with your right index finger form a whole while rotating the dough in your left hand, shape into oval or football-like forms and place a spoonful of filling in the centre. Seal well.
4. Heat oil to 170°C and fry kibbeh in batches for 4-5 minutes until golden brown.
5. Drain excess oil and serve hot with hummus, pomegranate sauce and/or a side of fresh greens.

Cooking tips

- Ensure the shell mixture is firm yet pliable for easier shaping.
- For a baked version, brush with oil and bake at 200°C for 25-30 minutes.
- Perfect Pairing: Serve with tabbouleh, or fresh mint leaves.

ABUNDA® Dates Power Bites

RECIPE BY EYAD KHAMIS

FOR 8 BARS OR 25 BITES

INGREDIENTS

- 100 g ABUNDA® mycoprotein
- 50 g dates molasses (syrup)
- 50-75 g tahini (to taste)
- 25 g dates
- 50 g walnuts
- 25 g dried cranberries
- 25 g sugar-free digestive biscuits
- pinch of salt

Optional toppings/add-ons:

- grated coconut
- dried figs
- cashew nuts
- lemon/orange zest
- roasted coffee beans

METHOD

1. In a mixing bowl, combine all ingredients and mix until well incorporated.
2. Shape into bite-sized balls or bars, depending on your preference.
3. Roll in grated coconut or crushed nuts for extra flavour.
4. Refrigerate for at least 2 hours before serving for the best texture.

Cooking tips

- For extra indulgence, dip in dark chocolate.
- Store in an airtight container in the fridge for up to a week.
- Perfect as a pre-workout snack or afternoon energy boost

One of Eyad's experiments: a sweet snack with mascarpone, rose water and pistachio

Thomas Val

Success sparked new ideas, pushing Thomas further into developing a range of dough-based applications for mycoprotein.

Thomas Val is a chef at Restaurant Wils in Amsterdam, a casual fine-dining restaurant where cooking is done over an open fire. He strongly believes that chefs could be very important and helpful in the future protein transition.

The study

Thomas began his exploration of mycoprotein the same way he approaches all ingredients – by tasting. As a chef, he is used to working with the most beautiful products and he is always in close contact with his suppliers. But this time, the base ingredient was nearly flavourless, making it a challenge from the start. Instead of relying on instinct and culinary intuition, he had to think more like a product developer.

His breakthrough came when he mixed ABUNDA® mycoprotein with brown butter. The mycoprotein absorbed the dark, caramelized milk solids, resulting in a deep, rich flavour. This experiment led to the next: using the leftover brown butter to bake bread. That success sparked new ideas, pushing him further into developing a range of dough-based applications for mycoprotein.

The results

He decided to focus on incorporating mycoprotein into several types of dough, not just as a gluten substitute, but primarily for its ability to create a unique texture. Rich in protein and packed with fibres, mycoprotein turned out to have surprising potential. The use of mycoprotein in gluten-free doughs gives a certain chewiness and texture that is very pleasant. The use of mycoprotein as an additive to different kinds of doughs would be interesting for future research, whether it is pastas, noodles or bread.

Deep Fried Mycelium ‘Fluffy’

RECIPE BY THOMAS VAL

EQUIPMENT

- deep fryer
- silicone mould
- spatula
- mixing bowl
- microplane, extra fine

INGREDIENTS

- 100 g chickpea flour
- 55 grams dry potato puree
- 135 grams mycoprotein water (mixed 1 on 1)
- 2.5 g baking powder
- 50 g egg
- 13 g fresh yeast
- 55 g vegan butter
- 3 g salt
- zest from 1 lemon
- 2.5 g curcuma
- 4 g cumin
- 1 small clove of garlic, grated
- 5 g lovage

METHOD

1. Mix the mycoprotein water, chickpea flour, dry potato puree, baking powder, yeast and egg together in a bowl.
2. Add the remaining ingredients together in another bowl and mix so the butter softens. When soft, add to the dough and incorporate.
3. Put the dough in a piping bag and pipe in the silicone mould. Let it prove until it has almost doubled in size.
4. Freeze the dough so it’s easy to unfold.
5. Fry golden brown in 2 minutes at 170 °C.

Cooking tip

Use an extra fine microplane to get the most garlic flavour and best lemon zest.

Mycelium Sour Tilla

RECIPE BY THOMAS VAL

EQUIPMENT

- mixing bowl
- spatula
- baking paper
- frying pan
- scale
- tortilla press or pan

INGREDIENTS

- 150 g gluten free flour
- 75 g pan white corn flour
- 75 g chickpea flour
- 8,5 g salt
- 45 g active rice sourdough starter
- 10 g sugar

METHOD

1. Combine all the ingredients together until it is a smooth dough.
2 Scale 15 grams of the dough between two sheets of baking paper. Use a tortilla press or a flat pan to flatten the dough.
3. Fry golden on both sides.

Mycelium tortilla's

One of Thomas' experiments: a sweet madeleine, served with yoghurt dip

Yacinth Pos

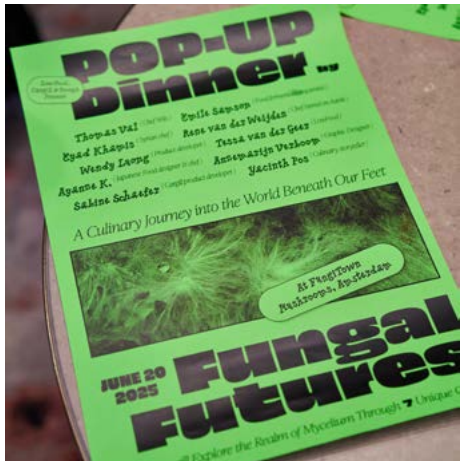
Yacinth Pos is a designer and chef who combines visual arts, performance and culinary arts to explore food and communal narratives. By creating dining experiences and installations, she reflects on broader issues and examines preparation methods, consumption patterns and cultural food rituals.

The study

Yacinth's approach was initially experimental. She wanted to explore various cooking techniques to see how mycoprotein would react. She was used to working with ingredients chosen primarily for their flavour, where taste played a key role in deciding how to use them. However, in this case, she had to completely rethink that approach. Since mycoprotein itself has little inherent flavour, the cooking process required a fundamentally different perspective – one focused on building and enhancing taste in new ways. This made both the product and the process of working with it an exciting challenge.

The results

Her experiments led to the creation of a mycoprotein beignet, with the filling, batter, emulsion on top and crumble all made from mycoprotein. As a designer and chef who tells stories through food, she realized she wanted to apply that same perspective to her work in the lab. This led her to explore the idea of organizing a mycelium pop-up dinner. Eventually, her research became less about what could be done with mycoprotein and more about how to bring it from the lab into the world. We see so much potential in mycoprotein, but how do we actually get people to try it and embrace it? Her goal is to create a positive first experience with mycoprotein for a wider audience – something that will soon become a reality!



Mycelium Beignets

RECIPE BY YACINTH POS

Filling

EQUIPMENT

- frying pan
- knife
- freezer
- microplane
- chopping board

INGREDIENTS

- 400 g ABUNDA® mycoprotein
- vegetable oil
- 350 g lion's mane mushroom
- 2 white onions
- 2 cloves of garlic
- 2 stalks of rosemary
- pinch of salt
- 8 teaspoons mycelium dip (see recipe)

METHOD

1. Finely chop the onions. Heat oil in a frying pan over medium heat and fry the onions until soft and golden brown. Make sure the pan is not too hot.
2. Cut the ABUNDA® mycoprotein into brunoises. Allow it to defrost slightly before use, but the structure should still be intact.
3. Remove the onions from the pan. Heat some more oil and fry the abunda, cook until all moisture has evaporated.
4. Add salt and one grated clove of garlic. Continue cooking until golden brown.
5. Cut the lion's mane mushroom into brunoises.
6. Remove the cooked mycoprotein from the pan. Heat more oil in the same pan. Sauté the lion's mane until golden brown. Add some rosemary and a grated clove of garlic.
7. Once all ingredients are cooked, mix the onions, mycoprotein and lion's mane in a bowl. Add 8 teaspoons of mycelium dip (see recipe).
8. Season with salt to taste.
9. Shape the mixture into small balls, approximately 3 cm in diameter, and place them in the freezer.

Batter

EQUIPMENT

- kitchen machine
- deep fryer
- mixing bowl
- whisk

INGREDIENTS

- 200 g flour
- 150 g corn flour
- a pinch of salt
- 300 ml beer
- 100 g ABUNDA® mycoprotein
- 50 g water

METHOD

1. Add the mycoprotein and water to a kitchen machine and blend until smooth.
2. Transfer the mixture to a bowl and add the flour, corn flour and salt. Mix thoroughly with a whisk.
3. Add the beer while mixing until fully incorporated.
4. Remove the mycoprotein balls from the freezer in batches to prevent them from defrosting too quickly.
5. Skewer each ball onto a wooden stick, dip it into the batter and deep-fry at 170°C until golden brown.
6. Repeat the process until all the balls are fried.

Mycelium dip

EQUIPMENT

- kitchen machine
- microplane

INGREDIENTS

- 40 g mustard
- 100 g ABUNDA® mycoprotein
- 100 g hazelnuts
- 150 ml water
- 150 ml vegetable oil
- half a lime
- half a teaspoon xanthan gum
- a pinch of salt
- 3 tsp agave syrup
- half a clove of grated garlic

METHOD

1. Roast the hazelnuts in the oven until they are golden brown. Let them cool.
2. Add the mycoprotein and water to a food processor and blend until smooth.
3. Add the mustard, agave syrup, salt, garlic and the juice of half a lime. Then, add the hazelnuts and blend. Make sure the mixture is completely smooth.
4. Slowly add the oil, make sure the mixture doesn't split. Add a bit of xanthan gum to stabilize.

Mycelium dough experiments by Yacinth Pos

Rene van der Weijden

Mycoprotein could be transformed into a powerful umami booster, following the right fermentation process.

Rene van der Weijden is the executive chef of Hemel & Aarde in Utrecht, where he experiments with fermentation. From simple lacto-ferments to complex soy sauces and amino pastes, he explores new ways to create new flavours.

The study

Because of the lack of flavour, Rene wanted to try to keep the texture of the mycoprotein in its pure form (really meaty) but incorporate flavour. That's why he came up with the idea of growing tempeh spores on the mycoprotein. Those spores give a big amount of flavour to a product. Because the tempeh works as a sponge it soaks up any kind of flavours, and also fat.
The first small batch of pure mycoprotein tempeh resulted in a dense, compact structure that didn't fully develop into the light, fluffy consistency he was aiming for. To improve it, he introduced cooked grains into the fermentation process, creating a 60/40 mycoprotein-to-grain ratio. This adjustment helped aerate the mixture, promoting better mycelial growth and resulting in a more balanced texture.

Additionally, he explored garum, a fermented sauce traditionally made from fish, after learning about mycoprotein's high protein content. By combining mycoprotein with koji, he aimed to generate a rich umami profile by means of amino acid development. Lastly, he experimented with XO sauce, replacing the traditional dried shellfish with dried vegetables and mycoprotein to create a plant-based version that maintained the luxurious texture and depth of the original.

The results

Rene found the results promising across all experiments, but the tempeh stood out as the clear winner. Its structure remained meaty while absorbing flavours exceptionally well, making it a compelling high-protein alternative. The garum also turned out flavourful, proving that mycoprotein could be transformed into a powerful umami booster following the right fermentation process. The XO sauce had a warm, rich taste, though the mycoprotein contributed more to texture than to flavour.

Mycelium Tempeh

RECIPE BY RENE VAN DER WEIJDEN

EQUIPMENT

- silicon mould of choice
- gloves
- scale
- sterilizer (or pure alcohol)
- pressure cooker
- cling film
- knife

INGREDIENTS FOR 8 PORTIONS

- 200 g cooked Dutch grains (rye, wheat, spelt combined)
- 200 g boiled buckwheat
- 700 +- ABUNDA® mycoprotein (press most of the moist out of it until you reach 600 g total)
- vinegar 12 g (natural)
- 10 g tempeh starter

METHOD

1. Use steriliser or pure alcohol to clean all materials you use for tempeh (mould, trays, spoons etcetera).
2. Cook the Dutch grains in 1 l water under pressure for 30 min and let them cool down until room temperature.
3. Cook the buckwheat in 1 l water until cooked but not completely soft! A little bit of bite is necessary, let it cool down to room temperature.
4. Press any excess liquid out of the mycoprotein until you have 600 g of the total weight and pull it in small bits. Add the grains and the buckwheat and mix in your spores and vinegar, mix thoroughly and try to keep the mass “fluffy” so air can pass through and spores can grow (aerobic).
5. Put the mixture in the shape you want and cover with cling film; press holes in the cling film to allow air through. Keep warm (28 degrees) for 32 hours until fully grown tempeh.

Cooking tip

Pan fry until golden and crispy and make your favourite glace to glaze after frying, make sure you get rid of excess fat before you glaze the tempeh.

JONAH’S ANALYSIS

“Incorporating mycoprotein in tempeh is a diversification of the protein source and could reduce dependence on soya cultivation. Soya cultivation is linked to biodiversity loss due to intensive farming practices.”

Mycelium XO

RECIPE BY RENE VAN DER WEIJDEN

EQUIPMENT

- food dryer
- pan with wide bottom for frying
- scale
- smoker
- wood chips or hay
- kitchen machine

INGREDIENTS

- 200 g ABUNDA® mycoprotein
- 30 g dried carrots chopped in pieces
- 10 g dried mushrooms
- 10 g dried seaweed of choice
- 30 g dried celeriac chunks
- 30 g (mycelium tempeh)
- 30 g dried pumpkin chunks
- 1 big onion
- 5 cloves of garlic
- 1 thumb ginger
- 30 ml cognac
- 30 ml dry sherry
- 1 tablespoon of Gochugaru
- 20 ml ramson soy sauce (or any other soy sauce)
- 50 ml black garlic vinegar (or sherry vinegar)
- 200 ml vegetable oil
- salt to taste

METHOD

1. Dry fresh chunks of vegetables (see above) until dry and “chewy” – 60 degrees for approximately 24h, depending on the size of the vegetables.
2. Mince it coarsely in a kitchen machine into small pieces
3. Finely chop the garlic, ginger and onion.
4. Chop the mycoprotein and the tempeh leftovers into small pieces.
5. Heat the oil in a frying pan; make sure it’s not too hot.
6. Add the mycoprotein and all the dry ingredients, the onion, garlic and ginger; cook out excess moisture, then add the Gochugaru to make sure it does not burn.
7. Add the wet ingredients and cook it until nothing is left.
8. Season with soy sauce and salt.
9. Let it cool down, then smoke the final product over hay or wood until it has absorbed a nice smoky flavour. The final ratio should be approximately 50/50 vegetables to mycoprotein.

Cooking tip

You can use it in noodles, in a salad or anything to give your meal a nice kick!

Mycelium Garum Paste

RECIPE BY RENE VAN DER WEIJDEN

EQUIPMENT

- gloves
- scale
- glass weck jar (jar with a rubber seal) with lid for approximately 1 l of mass (so a 1.5 l jar would work)
- rice cooker or other container that holds 60 degrees for a long period of time
- Sterilizer or pure alcohol
- hand mixer
- cling film

INGREDIENTS

- 150 g koji
- 200 g nurture yeast
- 500 g ABUNDA® mycoprotein
- 500 g water
- 100 g salt
- 100 g miso

METHOD

1. Sterilize your glass jar and all equipment before use.
2. Combine all ingredients and blend with a hand mixer until you get a smooth paste.
3. Transfer the mixture into the jar and clean the edges if necessary.
4. Cut a round piece of cling film and place it directly on the paste to prevent it from drying out and evaporating too quickly.
5. Put the lid on the jar, but don’t screw it on too tightly – some airflow is needed. If using a weck jar, removing the rubber seal from the lid should be sufficient.
6. Keep the paste at 60°C for 4 weeks, stirring every 2 days, until it develops a rich, chocolate-brown colour.

Cooking tip

You can use it in a sauce to enrich it, put it in a chocolate cake to give it that salty boost, use it in a caramel for a deeper flavour. Its best use as a condiment and not to eat it in its pure state.

Carlos Martinez, Zuzana van Beveren and Sabine Schäfer

Sabine Schäfer (left) and Zuzana van Beveren

Each technique, boiling, baking and deep-frying, created a different, unique texture.

Carlos Martinez, Sabine Schaefer, Zuzana van Beveren work on the Meat Alternatives Team at Cargill. Their expertise lies in developing innovative plant-based meat alternatives.

The study

Initially, the team planned to create ABUNDA® mycoprotein balls with vegetables. However, after the first tasting, they found the texture resembled pasta rather than a firm bite. This led to a shift toward high-protein ABUNDA® gnocchi – dubbed “Abiocchi,” a blend of “Gnocchi” and the Italian word abbiocco (food coma). Traditionally served with tomato sauce, the team instead leveraged ABUNDA®’s mycoprotein versatility to create a creamy white sauce. Their research approach was straightforward, and they used their expertise in meat alternatives to refine ABUNDA® mycoprotein’s texture. Naturally fibrous and soft, ABUNDA® mycoprotein was combined with vital wheat gluten and Cargill starches for the right consistency. The dough required only a kitchen mixer, while the sauce was blended with soy milk for a smooth result. One exciting discovery was the adaptability of Abiocchi dough. The team tested different pasta shapes, a ravioli-like version with mushrooms and even a samosa-style variant with vegetable curry. Each technique, boiling, baking and deep-frying, created a different, unique texture.

The results

The team found ABUNDA® mycoprotein highly versatile, producing textures from chewy pasta to smooth sauce. Abiocchi has strong potential as a high-protein pasta with a unique bite, offering consumers a customizable base for home cooking. It could complement fresh pasta options like gnocchi and ravioli or be sold as a ready-to-eat meal with ABUNDA® mycoprotein sauce. In addition, Abiocchi proved freeze/thaw-stable and easy to use, making it convenient for both consumers and manufacturers.

Abiocchi

RECIPE BY CARLOS MARTINEZ, ZUZANA VAN BEVEREN
AND SABINE SCHÄFER

JONAH'S ANALYSIS

"Gnocchi is usually made with potato, flour, and egg, using mycoprotein boosts protein and fiber while reducing reliance on animal-based proteins. Omitting egg further lessens the need for animal products while maintaining a nutritious and balanced dish."

20 SERVINGS

EQUIPMENT

- kitchen paddle mixer (KitchenAid)
- kitchen blender

INGREDIENTS FOR 2 KG ABIOCCHI

- 1212 g ABUNDA® mycoprotein
- 274 g tapioca starch
- 229 g panko breadcrumbs
- 152 g rapeseed oil
- 60 g vital wheat gluten
- 30 g vinegar (7 %)
- 17 g salt
- 10 g onion powder
- 10 g ground paprika
- 7 g parsley
- 5 g white pepper

INGREDIENTS FOR 2 KG WHITE SAUCE

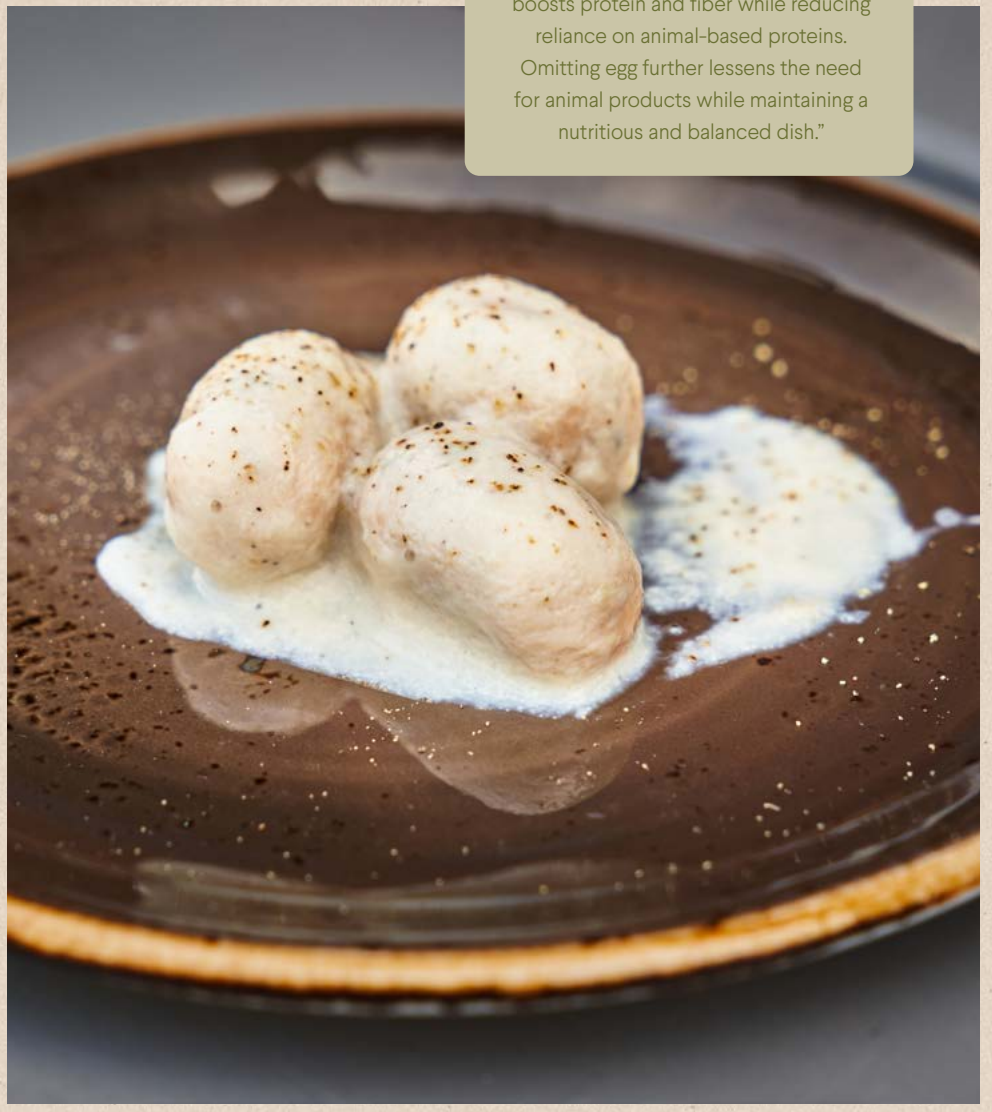
- 1350 g soy milk
- 280 g ABUNDA® mycoprotein
- 155 g soy cream
- 140 g shallots
- 30 g rapeseed oil
- 15 g salt
- 1 g ground nutmeg
- 1 g black pepper, ground
- 1 g ground cardamom

METHOD

1. For the Abiocchi dough, mix ABUNDA® mycoprotein with oil and vinegar for 2 minutes at medium speed.
2. Add the rest of the dry ingredients and continue mixing for 2 minutes until a homogeneous dough is created.
3. Shape Abiocchi (5 g each) and freeze until consumption.
4. For the sauce, slice shallots in small cubes and break ABUNDA® into small pieces.
5. Sauté the shallots and ABUNDA® mycoprotein pieces with the oil.
6. Add soy milk, soy cream and the dry ingredients and boil for 3 to 4 minutes.
7. Transfer the sauce in a blender and blend until a smooth homogeneous sauce is created.
8. The sauce can be stored chilled or frozen until consumption.

Cooking tips

- Heat up the sauce in a pot or pan.
- Cook Abiocchi from frozen in hot, boiling water for 4-5 minutes.
- Serve Abiocchi in the hot sauce.



Michael Kilkie from ENOUGH educates
the participants about mycelium and mycoprotein

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This publication is the result of a collaboration between Low Food and Flevo Campus.

Special thanks to
Cargill, Edwin Berends
ENOUGH, Craig Johnston, Michael Kilkie