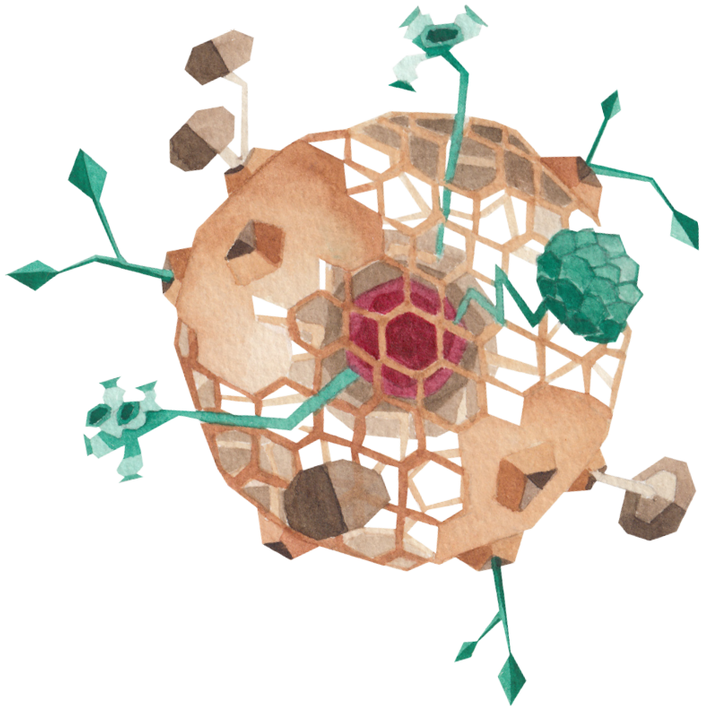

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From limitation to inspiration

A 3D food printer works essentially just like a regular 3D printer. Like its predecessor, the 3D food printer requires materials firm enough to carry themselves, but delicate enough to be pushed through the nozzle.

The most important elements of food printing are:
1. Hardware (the printer)
2. Software (the digital file that tells the printer what to do)
3. A food cartridge (edible printing material)

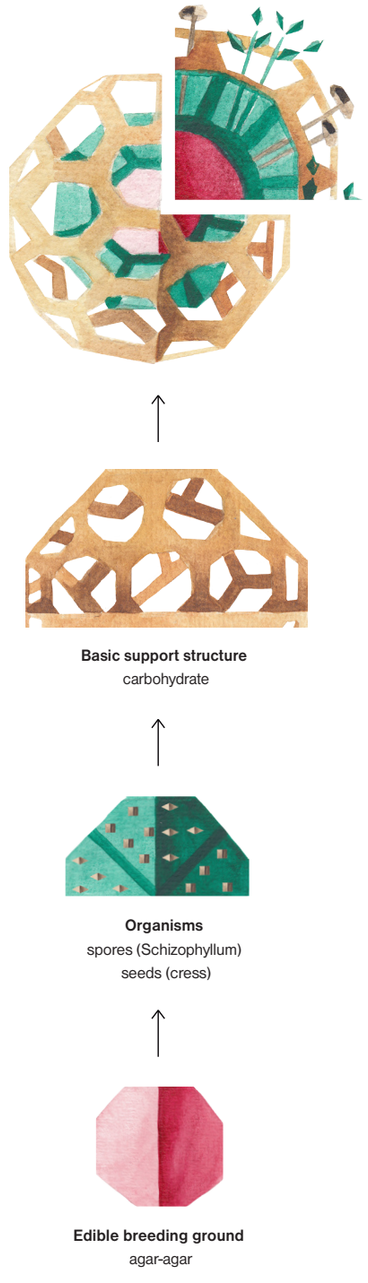
To print food, you need raw materials. These must be processed into a puree, powder or paste so that the printer can extrude or glue together the food. Especially in case of fruit and vegetables, the processing causes a decrease in nutritional value and a loss of texture. Moreover, it is difficult to print with multiple ingredients at the same time, and because the printer does not bake or cook the food, additional preparation is often still required afterwards.

These limitations explain why it is quite difficult to create healthy food using the techniques currently available. This made my challenge to print healthy food more complicated than I thought it would be. Racking my brain for an ingredient small enough to fit through the printhead so that it wouldn't have to be processed, I suddenly thought: organisms! Because who said the final product had to be fully printed? Why not refigure the printer as a tool to stimulate or even enhance natural growth? What if we printed with organisms such as seeds and spores? These are small enough to pass through the printhead, and could grow into nutritious and crispy food afterwards. A symbiosis between technology and nature. Proof that high-tech food needn't necessarily be artificial and unnatural; instead, technology could support natural growth and bring about exciting, sustainable food innovations.

Imagine a completely edible "mini vegetable garden" with crispy plants and mushrooms; an incomplete dish that becomes a full meal after it has been printed.

Edible Growth - how it works

Multiple layers containing a basic support structure, an edible breeding ground and various organisms are printed directly inside a tiny reusable greenhouse according to a personalized 3D file. The structure is designed in such a way that the different organisms cannot infect each other, but are all able to reach the breeding ground. After the edible is printed the consumer places the greenhouse on their windowsill where sunlight can reach it. The natural process of photosynthesis begins. Within three to five days, the plants and mushrooms are fully grown. The intensity of the taste and smell increases as the dish ripens, which is also reflected in its changing appearance. The consumer can decide when to harvest and eat the dish according to their preferred intensity.



Day one

Print the edible “mini vegetable garden”; an incomplete dish that only becomes a full meal after it has been printed.

Day five

Nature took over and covered the printed straight lines with organic growth. It’s time to harvest your Edible Growth!

A conceptual eating experience

Edible Growth-inspired mushroom risotto with red wine

Food is a very powerful means of communication. What we have seen so far is that, while the real product cannot be made yet due to its speculative nature, it's the story, and giving the audience an idea of how the product might look and taste in the future, that counts. I often serve Edible Growth as a main course during an experimental dinner. To make it a filling meal, I supplement the plants and mushrooms with a forest mushroom risotto cooked in red wine, topped off with cress and arugula. By serving the whole under a dome, I allow condensation to form on the glass, making it seem like a real greenhouse in which the Edible Growth has grown.

Instructions

Prepare four portions of red wine mushroom risotto. Take the dough out of the freezer and separate the sheets to defrost. Preheat the oven to 180 °C.

1. Top part of the Edible Growth (x4) | Use the glass to cut a circle in the dough and use the diamond-shaped cutter to cut out the holes for the dome. Place the incised dough circle over the curved side of the mold. Repeat three times. When finished, put the mold into the oven and bake for 15 minutes until the domes are baked and slightly tanned. Take the mold out of the oven and let it cool before taking off the dough.

2. Base part of the Edible Growth (x4) | Fold a sheet of dough over the curved side of the mold. Use a knife to cut off the additional dough to create a nice cup. Repeat three times. Bake for 15 minutes at 180 °C. Again, let the mold cool before taking off the dough.

3. Mise en place | Cut and clean as many mushrooms as you like to decorate four Edible Growth baskets. Mix the olive oil, apple cider vinegar, lemon juice, salt and pepper in a bowl to create the marinade. Carefully add the mushrooms and let them marinade for at least 10 minutes.

4. Finish the dish | Place the base cup on the bottom part of the glass bell and fill it with mushroom risotto. Take the top part of the crust and place it on the base part to form a ball. Stick some Enoki and Shimeji mushrooms inside the holes and add a few arugula leaves and puffs of cress to finish the dish. Cover it with the glass bell. Your Edible Growth is ready to be served!

Ingredients (4 pers.)

- 8 sheets frozen savory pie dough
- 1 bag of small arugula leaves
- 1 box of Shimeji mushrooms
- 1 box of Enoki mushrooms
- 1 box of cress
- pinch salt and pepper
- 1 tbs olive oil
- 1 tsp lemon juice
- 2 tbs apple cider vinegar
- 4 portions of red wine mushrooom risotto

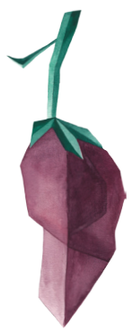
Material

- silicone half sphere molds (ø 7cm)
- diamond-shaped cutter (ø 1cm)
- glass (top part ø 9cm)
- knife
- tweezers
- bowl for marinade
- spoon
- 4x glass bell for serving

Recipe ‘ x ’

Recipe ‘ y ’

Recipe ‘ z ’



Scenario two - Infinity seed

Grow unlimited variations of one specific crop by experimenting with the variables in the recipe. Design crops with new flavors, shapes, textures and colors, and share your creations with the world.

Back to the Roots

3.

STROOOP!

How does our perception of an ingredient change from “healthy and natural” to “unhealthy and unnatural”?

For many products we simply know whether it’s healthy or unhealthy; a carrot is clearly healthy, and a sweet fizzy drink is not, right? We grow up learning that fruit and vegetables are good for us, and that pastries, sweets and chips are not and should be consumed with moderation. As it turns out, it’s not as simple as that.

Some time ago, when I was preparing sweet potatoes in the oven, I noticed a thick caramel-like substance running out of them. It was an incredibly sweet syrup, which made me reconsider my view on sweet potatoes as “healthy”; how could something as sweet as candy still be considered a healthy vegetable? Knowing that tuberous plants such as (sweet) potatoes, beets and carrots contain lots of carbohydrates, I realized that these carbohydrates are in fact built from sugars, starches and fibers. Heating the potatoes caused the complex carbohydrate chains (disaccharides) to break down into simpler glucose molecules (monosaccharides, 2x glucose), which resulted in the sweet potato releasing its sugars and “becoming sweet” during the baking process. I wondered why I had never asked myself what exactly was inside the raw ingredients I’m eating, and realized that each processing method has a different effect on the nutritional value of the food.

Struck by my own astonishment and the extreme sweetness of the potato, I got thinking about how consumer perception of a given product could shift from “healthy and natural” to “unhealthy and unnatural.” If we were to take the natural sweetness of the potato, and turn it into a completely different “type” of product, with virtually no additives, would people then—regardless of the type of product—consider it healthy, because it’s entirely made from vegetables?

Personalize your diet

Generally speaking, our current diet consists of approximately 45-60% carbs, 15-20% protein and 20-35% lipids—although not everyone has the same nutritional needs or goals. This technology would allow us to personalize the composition of our diets by simply changing the proportions of the nutrient layers. For example, an athlete in need of a lot of energy could increase the amount of carbohydrates in his diet. If you're looking to gain muscle instead, you can simply reduce the percentage of lipids in your diet and increase the percentage of proteins. In addition, the amount of micro-nutrients—and perhaps even additional medicine—could be manually adjusted before printing your personalized digestive food. Digestive Food could be specifically interesting for certain target groups including astronauts, elderly people and the severely ill.

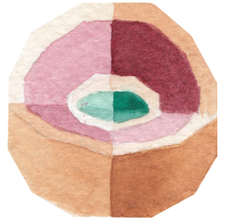
But however sustainable, functional or healthy the Digestive Food is, if we want people to embrace this new eating system, the food needs to have a certain look, feel, and not least, flavor. How to turn a highly functional eating system consisting mainly of tiny capsules into something delicious?

Why not enrich the eating experience by "seasoning" the food with customized smells, textures, colors and crunch?

Flavor is the sum of taste, smell and texture. Researchers have found that nearly 80% of a food's flavor is determined by its retronasal odor (smelling through your mouth). The smell of food helps us to identify complex flavors and associate them with strongly rooted memories of food. Without smell, we would only be able to identify the five basic tastes: salty, bitter, sweet, sour and umami. In addition to this, the texture, shape, color and sound of food all strongly influence our perception of the flavor.

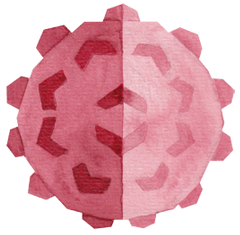
So, if the look and basic taste of the capsules is not appetizing enough, why not enrich the eating experience by "seasoning" the food with customized smells, textures, colors and crunch, with the help of digital fabrication technologies?

Low carb diet
for losing weight

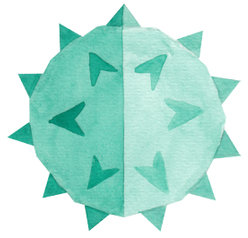


High protein diet
for gaining muscle

Low fat diet
for losing weight



Sweet
rounded, pink, smooth.



Sour
spiky, yellow/green.

Umami
edged, organge/brown.