

## Solein<sup>®</sup> Q&A

### **Q: Background: What was the inspiration behind Solar Foods?**

Solar Foods is a food tech start-up that was founded to commercialise the research that was carried out in VTT Technical research centre of Finland and LUT University (Lappeenranta-Lahti University of Technology).

The key observation during the research was: exploring fossil fuels from the ground, burning them, and releasing the formed CO<sub>2</sub> in the atmosphere is fundamentally a bad idea. Instead, all of this should be reversed.

Therefore, the founding team wanted to develop a solution for turning emission-free electricity and CO<sub>2</sub> captured from air to edible calories (food). To achieve such a complex task, a living cell was identified as the best factory to do the job.

After the proof-of-concept at VTT, Solar Foods was founded in November 2017 and started operation in March 2018.

### **Q: Solar Foods' solution for protein production sounds artificial. Is it?**

Solar Foods is only taking advantage of the diversity in nature. Solein<sup>®</sup> is protein in its most natural form. It is not artificial, although understandably it is non-traditional and entirely new.

What is also new is the way this new harvest is grown and collected. It has not been possible for hunter-gatherers 100,000 years ago, or the modern human race up until today to collect single cells from the nature for food. Solar Foods now brings this new harvest available for the humankind.

### **Q: How does the production work?**

Solar Foods has collected microbes from the Finnish nature and grows them in a fermenter that is almost identical to the fermenters used in breweries and wineries.

Solar Foods' microbes are put in a liquid – called growth medium – within a fermenter. The liquid is continuously supplied with small bubbles of hydrogen and carbon dioxide, as well as some nutrients including nitrogen, calcium, phosphorus, potassium etc., which are the same nutrients that plants normally absorb through roots from the soil.

The microbes eat these ingredients to grow and multiply. As the liquid grows thicker, some of it is continuously removed and dried. The dried powder is, in fact, the whole cells that are up to 65% protein. The macronutrient composition of the cells is very similar to that of dried soy or algae.

### **Q: Can you really produce food only from air?**

All the main ingredients: carbon (CO<sub>2</sub>), hydrogen, oxygen and nitrogen can be captured from the air. In addition, the electricity used for the processing is both solar and wind power.

In the end product, a few percent consist of inorganic nutrients, such as phosphorus and calcium, which cannot be taken from the air.

**Q: Does the production of Solein consume a lot of energy?**

With the best available technology, the efficiency from electricity to calories is about 20%. By hectare, the yield in Solein is 10 times more than photosynthetic plants – even if the electricity for Solein production would be from solar panels (that needs quite a bit of land area).

Theoretically speaking, if all the calories for Finns would be produced by means of the Solar Foods technology, this would require 10% from the primary energy use of Finland and one third of the electricity consumed today in Finland.

**Q: Does Solein production remove carbon dioxide from the atmosphere?**

It does not permanently remove carbon dioxide from the atmosphere, but it circulates it. Therefore, it can be thought as carbon neutral. CO<sub>2</sub> is removed from the atmosphere if so-called direct air capture (DAC) technology is used to get the required CO<sub>2</sub>, but once the food is consumed, carbon returns to the atmosphere through respiration in the form of CO<sub>2</sub>.

In a scenario where Solein would replace plant or animal protein, and the freed land is utilised for growing trees, then Solein production is a net sink of carbon dioxide from a climate-change perspective (so-called carbon negative technology).

**Q: How is Solein used: Do you expect people to eat only powder or pills in the future?**

Solein is expected to be used as a protein ingredient in existing foods such as bread, pasta and plant-based dairy, drinks, and between meals.

Secondly, Solein is planned to be used as a protein ingredient in meat alternative products.

Thirdly, if laboratory-grown meat production will scale in the future, Solein could provide the amino acid platform that real meat cells could use for growing.

Therefore, Solar Foods' technology should be seen as a platform technology for disconnecting food production from agriculture in a strategic manner, rather than just a production of protein ingredient.

**Q: When can we buy Solein in supermarkets?**

We aim at to be on the market in 2021.

**Q: What is the status of the development now?**

Solar Foods is operating a pilot plant in Espoo where the technology has been scaled up 1000 times from that in 2018. With a design capacity of 1 kg/day, the pilot plant is built to be a complete replica of the future full-scale factory.

**Q: What challenges have you faced and what are the left to resolve?**

Solar Foods has scaled the production up 1000 times in one year. Another 1000-time scaleup is needed in order to commercialise the protein. This is an intellectual, scientific and technological challenge.

Even if technical challenges are overcome, there is also a lot to do in terms of food product development, factory engineering and construction, as well as novel food permitting.

## **Q: Is Solein safe?**

Solein will be proven 100% safe. This means it needs a novel food approval from authorities before it can be sold as food and this process is on-going. Solar Foods is now generating safety and property data based on its pilot-scale production. We do not have any evidence that Solein would not be as safe as any existing food.

## **Q: Is Solein healthy?**

For the time being and based on the analysis done so far, we do not make any health claims in comparison to other plant or meat-based protein sources.

Solein contains all the essential amino acids, carbohydrates, fats and vitamins as any other food. Solein is very high in protein – up to 65%.

## **Q: Is it vegan?**

Yes.

## **Q: Is it a complete protein?**

Yes. It contains all the amino acids essential to human diet. Based on chemical analyses they also exist in an adequate proportion.

## **Q: Is it environmentally friendly?**

Based on a lifecycle analysis study, Solein is about 10 times more climate friendly than most plant-based proteins and about 100 times more climate friendly than meat.

## **Q: Does Solein resolve global environmental problems and hunger?**

We are not proposing Solein to make up a full diet of a person. However, based on scientific evidence Solein is the most environmentally friendly protein. If it replaces meat in human diet, its climate impact is significant.

Solein production does not require fertile land and it is very efficient in water use, therefore it can provide nutrition for water scarce areas and those short in agricultural land and conditions.

## **Q: What is the Mars project about?**

Solar Foods co-operates with ESABIC (European Space Agency Business Incubator) in order to study pre-feasibility for producing Solein during Mars mission. Initial results show it can be done. Solar Foods hopes to continue the Mars mission in 2020 and beyond.

**Q: What is so unique about Solein?**

Solein is aimed at to be the first food on the market that is produced without agriculture and without fossil fuels i.e. the energy used in the processing comes from renewable resources (wind & solar power). The food is novel food, meaning it is food never made available for commercial use before. We are bringing a completely new harvest to the humankind.