

## Alternative source of protein

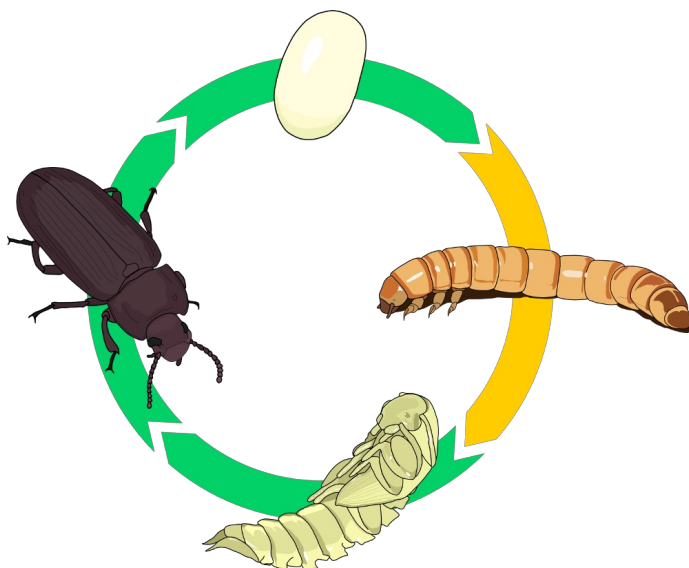
# Smart insect farms as sustainable protein sources of the future

**It is estimated that by 2050, if not before, the world's population will have grown so much that it will be difficult to provide adequate supplies of food for everyone. It is therefore high time to look for alternatives. One option could be insects as an environmentally friendly source of protein for humans and animals. The start-up company Cepri is developing smart insect farms with the goal to make primary production, which is not yet competitive, data-driven, efficient and self-optimising.**

The United Nations estimates that the current world population will grow from around eight billion to almost ten billion over the next thirty years. This is at a time when our resources are already stretched to the limit: the supply of food is already poor in many parts of the world and the population of the regions affected is undernourished. If nothing changes with regard to the quantity of food and to the way food is produced, these problems might soon start affecting other regions that currently have access to sufficient food.

More than anything else, providing protein for humans and animals, which currently mostly comes from conventional livestock farming, is likely to become difficult. It is estimated that an increase of roughly 60 percent in animal protein production will be required to cater for growing protein needs. This is not only almost impossible with current methods, but also harmful to the environment: even now, around 18 percent of all greenhouse gases produced annually come from livestock farming, 32 percent of all drinking water used in agriculture and 70 percent of agricultural land is used for livestock farming.

## Sustainable circular economy with insect farms



The life cycle of a mealworm from egg, larva, pupa to beetle.  
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Insects have the potential to make a sustainable contribution to resolving this problem. That is why after completing their studies, biologists Lucas Hartmann and Marcel Lieber set out to find organisms that might be up to such a task. They came across the mealworm, the larval form of the flour beetle *Tenebrio molitor*, as a possible alternative to conventional meat production. This larval species only uses a fraction of the water, land and feed resources currently used by livestock farming to produce the same amount of protein as a cow, while at the same time emitting up to 200 times fewer greenhouse gases. "We thought that this was an excellent solution," Hartmann reports. "But unfortunately, the market is nowhere near that level of development. We therefore want to optimise insect farming in order to open up the market as quickly as possible and make insect products competitive."

The two biologists founded the company Cepri in Karlsruhe in 2017 with the aim of permanently establishing insects in the food chain. "Cepri, or Kephri, is an Egyptian scarab that was associated with the regenerative forces of the rising sun in ancient Egypt. So

we chose this name to allude to the increasing use of insects in a sustainable circular economy," explains Hartmann. "Initially, we planned to work with partners on the development of a decentralised and smart insect farm concept that would cover the entire process from primary production to marketable insect meal. Among other things, we decided to specialise in egg production and develop a process for breeding *Tenebrio molitor* beetles, harvesting eggs and sending them to partner

companies (insect farms) that would raise the larvae and process them into insect meal and other products. However, we soon realised that insect farmers preferred to carry out the entire primary production process, i.e. including producing the insect eggs themselves, so they would not have to depend on egg producers, which is common in poultry farming, for example. At the same time, however, we discovered that the beetle reproduction process was characterised by a big knowledge gap and lack of industrial methods and technologies. It seemed that this process had huge innovation potential. We therefore decided to change tack and focus on optimising the insect breeding process by developing and tailoring automated and data-driven mealworm reproduction processes to the requirements of insect farmers. After all, we had already gained a lot of experience in this field from the initial project and were also able to establish a global network."

## Automated insect breeding optimises itself again and again

Insect breeding is a labour-intensive but at the same time sensitive process that requires the optimal combination of technology and biology. "After all, the process involves living organisms that react to environmental conditions," says Hartmann. "This implies that the reactions of living organisms to changing environmental conditions would also require the breeding system to be adapted accordingly. However, we need to collect a huge amount of data to be able to automate the process. Only then will we be able to make the switch from experience-driven breeding to data-driven breeding."

Cepri is currently focusing on collecting the parameters required for designing smart insect farms: among other things, a camera system is used to count beetle eggs, determine the weight of the eggs and record egg-laying and hatching rates, growth potential, age and sex of the individual insects. "Our goal is to develop a system to the stage where it will be able to continuously optimise itself," says the company founder. "As far as our company is concerned, we are still at an early stage of development, and are also looking for co-founders, collaborators and mentors. But the work we're doing right now will be worth it." Data are currently collected using boxes of around 10,000 insects each. Industrial scale farms would have to be equipped with at least 30,000 stackable boxes in order to optimise the floor space.



Mealworms could be processed into a wide variety of products and become part of our protein supply in the future.  
© Cepri

## Insects are safe food for humans and animals

The experts from Karlsruhe believe there is significant potential for various products made from mealworms and other insects such as flies or crickets: mealworms and other insects can contribute to human nutrition in a similar way to conventional meat products and are actually already found as burger patties or protein bars on some supermarket shelves. Only recently, the European Food Safety Authority (EFSA) gave the green light for insect-based foods after mealworms had been found safe for human consumption. "This brand-new decision will give the market a huge boost," says the biologist. "We are only just in the starting blocks, but I believe that thousands of insect farms will be established in the not-too-distant future." The company plans to specifically target children and young adults whom they believe are much less inhibited than adults when it comes to consuming insect-based food products.

Insect-based products could have even greater potential - at least in the short term – as animal feed, including feed for aquacultures, in poultry farming or as pet food. But further processing, with a special focus not only on proteins but also on fats and carbohydrates, is also conceivable, for example for use in the cosmetics and textile industries. Complete insect carcasses are already used as an organic fertiliser in agriculture.

## Pilot phase to start this year

"Insects have huge potential for all kinds of industries," says Hartmann. "We know of around 430 companies worldwide that focus on insects and around 50 percent of these are involved in primary production. The increasing need for proteins is also gaining more and more public attention. So we believe that the market for insect-based products will develop rapidly." Hartman also mentioned that fishmeal, soy and other plant products, fungi and algae and in-vitro meat compete with insect products, but foresees that a number of different solutions will be required in the future in order to close the protein gap and protect the environment.

The expert further reports that potential smart insect farm customers already exist. He comments: "At the moment, however,

we only provide consulting services and write breeding protocols, for example." But the insect farmers are also interested in other solutions. That's why Cepri is planning to complete the first insect farm prototype this year and commence a pilot phase. "The data we will collect during this pilot phase will help us find out whether everything works as well as we hope," highlights Hartment, going to add, "and then we hope to be able to attract larger investment sums to continue developing the prototype into industrial insect farms that could be used to produce many thousand tonnes of insect meal per year."

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## Article

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