

From fly larvae to fine food

Humankind clears rainforests to cultivate soybeans and overfishes oceans to obtain fishmeal. Fraunhofer IME has come up with a more sustainable way of sourcing valuable protein. Now if only the soldier fly could break through the yuck barrier.

By Christine Broll

Andreas Vilcinskas spends a lot of time these days talking to investors and bankers, traveling to their haunts in Singapore and London or meeting them at home in Giessen. Wherever these talks take Professor Vilcinskas, he always has to field the same sort of question from the moneymen and women: Should we really be investing our pretty pennies in these ugly bugs?

The professor has a reassuring answer ready: "Insects are going to be the feed of the future for livestock. They also provide a sustainable, climate-friendly way of producing animal protein." Andreas Vilcinskas heads up the Biore-sources department of the Fraunhofer Institute for Molecular Biology and Applied Ecology IME. He is confident that insect biotechnology's time has come. If not now, then when? As a specialist who has had a formative hand in shaping this field of research, he is certainly qualified to address that issue: "Rain forests are being cleared to grow soybeans; oceans are being overfished to produce fishmeal." The production of livestock feed clearly causes great environmental damage. The solution, according to Andreas Vilcinskas, is insects. They provide valuable proteins and fat – yet their ecological footprint is minimal. Insect farms also look to be an excellent business prospect, which appeals to investors.

Andreas Vilcinskas and his team will have a new 30-million-euro building at their disposal in Giessen by mid-2020. Funded in equal parts by the state of Hesse and the German federal government, this facility is to accommodate a hundred scientists. Alongside an array of labs, it will have a greenhouse for rearing insects. This new Fraunhofer Institute for Biore-sources is going to research the full spectrum of insect biotechnology. Hexapods are more than just a great source of protein; they are an all but inexhaustible wellspring of natural substances that serve useful purposes in medicine and crop protection.

The larvae of the black soldier fly, *Hermetia illucens*, make good livestock feed. Growing to a length of two centimeters, these flies inhabit tropical and subtropical regions worldwide, including southern Europe and parts of the Balkans. The Indonesian island of Sumatra will soon be home to the world's biggest black soldier fly farm. Construction of a breeding facility is underway with a little scientific help from the entomologists at Giessen. Built to the tune of a half a billion dollars, this plant is going up next to a huge palm oil factory, the leftovers of which are to feed the flies' larvae.

The first priority of Vilcinska's team is to develop a process to break down the pressed shells of oil palm seeds so that flies can digest these waste products. The residual pulp goes into flat boxes, which are then populated with freshly hatched larvae. Growing to a good two centimeters within two weeks, these larvae wiggle their way out of the substrate once they are mature enough to pupate. Come harvest time, fly farmers take advantage of this migratory instinct to simply collect the larvae, which are then freeze-dried. The extracts contain some 40 percent protein and around 35 percent fat. These fractions are mixed to make feed tailored to the nutritional needs of various livestock such as fish, chickens and pigs.

A natural-born survivor

Sumatran palm oil production is expected to churn out more than a million metric tons of residual plant matter a year. These leftovers will serve as the substrate for growing fly larvae. "Diseases can always be a problem with a stock as big as this," cautions Andreas Vilcinskas. He and his team are developing a pathogen monitoring system with this in mind. "We definitely want to work without antibiotics to avoid polluting the environment." He also wants to maintain the green reputation that insect protein has earned. ►

Harvested larvae are freeze-dried; the extract contains 40 percent protein.



“Learning from insects means learning to win.”
 Prof. Andreas Vilcinskis is a trailblazer in insect biotech.
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“The larvae produce anti-microbial peptides.”

Prof. Andreas Vilcinskis

► Chances are good his plans will pan out. The larvae of the soldier fly are natural-born survivors with an impressive immune system, perfectly adapted by nature to grow up amid rotting waste and dung teeming with germs. Vilcinskis and colleagues at the University of Dresden and the Max Planck Institute for Chemical Ecology are investigating how these flies manage to keep pathogens at bay. The team found more than 50 different antimicrobial peptides in the insects to explain their larvae’s remarkably robust immune system. Even more remarkable is that the spectrum of peptides produced by these animals changes with their diet. “By optimizing the food used to rear larvae, we can make sure they produce antimicrobial peptides to ward off key pathogens such as salmonella and listeria,” says Vilcinskis. “These peptides end up in the insect meal, protecting it against bacterial contamination.”

A fly in the food chain – from larvae to chickens to humans

The market prospects for insect protein look brightest in Indonesia and neighboring countries, where people have no qualms about feeding it to animals. Insects also figure prominently in local traditional cuisine. The likes of grilled grasshoppers and fried silkworms have long been popular delicacies for humans.

People in Africa, too, are open-minded about insect-based livestock feed, so farmed soldier flies could go a long way toward enriching the population’s diet with protein. A pilot project in Kenya is a case in point. A startup called Sanergy has set up portable toilets in the slums of Nairobi. The company regularly empties their tanks, collecting human excrement in large barrels that go to an insect farm, where it is mixed with waste from restaurants and fed to black soldier flies. The larvae are processed into chicken feed, the chickens lay eggs, people eat the eggs and then – to put it delicately – the perfect recycling economy comes full circle.

Inhibitions run highest in Europe. Feeding animal protein to livestock had been a no-go since the EU banned the practice

in the wake of the BSE epidemic. Contaminated meat-and-bone meal was thought to cause the spread of mad cow disease. It was not until 2017 that the EU relaxed the regulations and has since allowed fish farms to use insect-based feed. However, larvae reared on waste are still taboo. Andreas Vilcinskis expects the EU to permit insect-based feed for other livestock as well, first for poultry and then perhaps later for pigs.

Companies seeking to commodify the black soldier fly in Europe share that hope. Suppliers in Germany do business on a very small scale, growing larvae for pet fish and reptiles or making cat food with insect meal. Larger companies in Belgium and the Netherlands are investing to plant a footprint in this emerging market.

At the top of the pyramid, a gourmet eatery

The EU ban on larvae fed with manure or catering waste makes life hard for businesses seeking to turn a profit with fly farms. Rearing larvae with approved feed such as grains is ecologically unsound. This is why Andreas Vilcinskis has opted to go with organic by-products sourced from the food industry, such as pomace – the pulpy leftovers of apples pressed to make juice. To demonstrate that this line of business can indeed create value in Germany, he is setting up a closed system in which fly larvae serve as food for upmarket shrimp. Turning the lowly black soldier fly into pricey black tiger prawns certainly does that. Part of the “Bioökonomie im Ballungsraum” [*Metropolitan Bioeconomy*] initiative, this project is funded by the German Federal Ministry of Education and Research. ■

Insects’ long march to the table

Europeans are most circumspect about the notion of insects as food, a reluctance born of the BSE epidemic. That is beginning to change. People are now free to dine on edible insects in the EU since Brussels gave its official blessing in 2018. More and more are overcoming their inhibitions to nibble a bit of bug here and snack on a crispy cricket there. And for good reason: insect-based food is healthy and ecofriendly. Foodies can now buy freeze-dried grasshoppers and buffalo worms, and consult cookbooks with recipes on preparing roasted mealworms on a bed of herbs or crickets with honey and sesame seeds. Some supermarkets already offer insect protein bars and frozen insect burgers. Resident expert Andreas Vilcinskis is confident that insect-based products will have gone mainstream in ten years’ time.