

Not-so-creepy crawlies



Biotech is embracing insect protein as a meat alternative. Will the rest of the population follow?

Edible insects are packed with protein. One typical serving of grasshoppers or crickets contains 14 to 28 grams of protein, approximately the same amount as in a serving of chicken or beef. Insects are also high in other micronutrients¹ such as iron and vitamins, although the exact quantities vary depending on the insect. While consuming insects as food is common in parts of the world such as Asia, Africa and Central America, people living in Western countries would need to be mightily convinced to eat a dish made with beetles or ants. At best, eating insects is considered a novelty – something done once or twice, but not as part of a normal routine.

And yet there is an environmental imperative to eating insects. As the global population grows, so does its appetite for meat. This need for high-quality protein puts pressure on farmers to grow more livestock, which requires more land and more animal feed. Agriculture is today responsible for approximately 14.5% of global greenhouse gas emissions, and this number is climbing. Insect farming could offer some alternatives.

Insects emit fewer greenhouse gases and less ammonia than cattle or pigs, according to the [United Nations' Food and Agriculture Organization \(FAO\)](#). Pound for pound, farming insects requires less water and feed than traditional livestock. On paper, switching to insect farming seems like a winning situation.

The main hurdle is a marketing one: to persuade humans to increase their insect consumption. But how can people who consider insects 'dirty' or 'icky' be convinced to give them a try? The benefits of eating crickets have been discussed for years, but there still are not many converts in the Western world who would choose the grasshopper on the menu.

The trick will be to make insects taste better than their beef and chicken counterparts. Crickets can be ground into powder as a replacement for traditional protein supplement powders, or as flour for use in baked goods, but these powders are made to be flavorless and are only consumed by

a small percentage of the population. The world-famous Copenhagen restaurant Noma has experimented with [serving insects](#) on its menu for many years, including bee mayo, grasshopper garum and salted larvae. Although the restaurant will close in 2024, they will maintain their experimental food lab that, over the years, has pioneered efforts to study how bugs could enter Western cuisine and be adapted to people's palates. Noma has made garum, for instance, a fermented sauce popular in Roman times and traditionally made with fish guts, but with grasshoppers instead. Garum imparts a strong umami flavor to dishes: a few drops of insect garum could [transform a vegetable](#) or insect-based dish, making it more appealing as a meat alternative.

And once the stigma that surrounds eating insects is overcome, the next obstacle will be to ensure their mass production remains sustainable. In countries where insect consumption is routine, these insects are often harvested directly from nature. If the demand for insects grows, harvesting them from the natural habitat would be neither feasible nor desirable. Insect farming needs to happen in a closed environment, so that the food source is available year-round rather than seasonally. Insects also need to eat, and the quality of their food will determine their protein and nutrient composition. Insect feed will need to be sourced from elsewhere, and feeding and raising [100 million crickets in a single facility](#) is no small task. We will need to automate farming processes and make the whole enterprise more efficient.

There have been some small-scale successes as scientists have generated insect farms to provide for specific populations in need of protein sources. UK-based company [SEED Madagascar](#) helps people in Madagascar communities to grow bean plants that are eaten by the cricket-like insect sakonry, which the locals then farm and eat as snacks. In one year, their sakonry farms harvested [over 90,000 insects](#), or about the protein equivalent of 2,700 eggs.

Insects are not just useful as a protein source for humans; they are increasingly being used as feed for poultry, fish, pigs, cattle and even pets. In this issue of *Nature Biotechnology*, a News Analysis² highlights some advances using CRISPR and gene editing of insects to

ramp up production. Companies producing black soldier flies (FreezeM) and mealworms (Ynsect, BetaHatch) have received investments that will enable them to reach European and Asian markets. The market could reach \$1.14 billion by 2027.

FreezeM has used CRISPR–Cas9 to target metabolic genes in black soldier flies to yield strains with bigger larvae and increased stress resilience or to engineer strains with a higher lipid content, to be competitive with crop oils. Until recently, gene editing of insects was difficult, mainly as a result of issues with delivery, and genome editing tools have been used with only a small subset of insects. Micro-injection of insect eggs was the primary means of cargo delivery, and this process needs to be optimized for any specific insect. It also is not easy to screen for desired traits. There are new approaches that have been developed to get around these issues, such as ReMOT³ and DIPA-CRISPR⁴, which inject female adult insects and induce mutations in developing oocytes. Better insect genome sequences are enabling researchers to learn more about relevant gene pathways in insects as well.

Companies are also using selective breeding. Ynsect uses a genotyping chip developed for mealworm breeding to identify which larvae contain genes linked to traits of interest, such as disease resistance or growth performance. Similar technologies could be developed for other insects and used on large scales with automation.

The meat-alternatives market has been predicted to grow from \$13.9 billion in 2023 to \$230 billion in 2030. Insect farming could be a contributor to this growth, although right now the percentage is small. Maybe a way forward is for companies to replace a percentage of your pork sausage or chicken burger with cricket or mealworm protein. Or, if you want to just go for it, find yourself some [salt-roasted crickets](#) with your cold beverage this summer.

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References

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