**Headline:** Cruelty-Free Fashion: Growing Leather Without Animals

**Teaser:** It’s now possible to grow leather without raising and killing animals.

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**[Article Body:]**

A warehouse filled with huge gleaming silver vats hums around the clock, as billions of yeast cells work to make a material we can wear, sit on and carry around. In an adjoining room, rows of benches hold molds of different shapes and sizes, where sheets of cellulose layer up and become recognizable. In the next room, the material is finished and packaged, destined for designers, tailors and upholsterers.

This is the scene of a biofabrication plant, producing leather without the animals. A futuristic ideal? Companies like [Modern Meadow](https://tinyurl.com/8jx49ys) don’t think so. As the firm’s cofounder [Andras Forgacs](https://twitter.com/atforgacs?lang=en), a biofabrication pioneer, said during his [2013 TED talk](https://www.youtube.com/watch?v=7gXq1ml6B1E): “Perhaps biofabrication is a natural evolution of manufacturing for mankind. It’s environmentally responsible, efficient, and humane. It allows us to be creative: We can design new materials, products … and facilities.”

The company successfully [debuted a cultured leather T-shirt](https://www.modernmeadow.com/) in 2018. The company recently celebrated its 10-year anniversary in October 2022 with a new CEO, Catherine Roggero- Lovisi. Modern Meadow’s staff of 143 is working away at a production plant in Nutley, New Jersey, with the goal of revolutionizing fashion and the materials industry—and changing the way we think about animal products.

**More Vegans, but Also More Cows**

Veganism is steadily [on the rise](https://www.reportbuyer.com/product/4959853/top-trends-in-prepared-foods-2017-exploring-trends-in-meat-fish-and-seafood-pasta-noodles-and-rice-prepared-meals-savory-deli-food-soup-and-meat-substitutes.html). Only 1 percent of Americans identified as vegans in 2014; by 2017, the proportion of the plant-based eating population had grown to 6 percent. As of 2022, that figure is 10 percent. And while U.S. proportions are comparatively low—in India, [as many as 42 percent](https://en.wikipedia.org/wiki/Vegetarianism_by_country) of people are vegan—Americans are moving to veganism in strong numbers. In 2021, plant-based foods sales grew three times faster than overall food sales, [according to](https://gfi.org/wp-content/uploads/2022/03/2021-U.S.-retail-market-insights_Plant-based-foods-GFI.pdf) the Good Food Institute.

However, while a greater proportion of the population is moving off of meat diets, there hasn’t been a drop in the world’s cattle population, which has been [increasing steadily since 2015](https://www.statista.com/statistics/263979/global-cattle-population-since-1990/) and currently stands at more than 1 billion cows.

A number of factors could be contributing to this discrepancy, the leather industry being one: valued at $93.2 billion in 2016. The industry has since [grown](https://www.grandviewresearch.com/industry-analysis/leather-goods-market) to $407.9 billion in 2021 and is expected to reach $424.6 billion by the end of 2022. Initially, it was [expected to grow](https://www.researchandmarkets.com/reports/4395563/global-leather-goods-market-by-mode-of-sale) to $121.16 billion by 2022. [Reasoning](https://www.theatlantic.com/business/archive/2008/01/should-vegetarians-wear-leather/2595/) that leather is a by-product of the meat industry ([which it isn’t](https://www.theguardian.com/lifeandstyle/2008/aug/27/ethicalfashion.leather)), people are often quicker to pull on a pair of leather boots than tuck into a burger. Yet a glance at the process behind leather manufacturing suggests that walking in those boots may be doing more harm than eating a meat-based diet.

**Not Just Emissions: Livestock’s Chemical Impact**

Livestock, many of which are reared for their hide, produce an [estimated 14.5 percent](https://tinyurl.com/zonnqet) of global anthropogenic greenhouse gas emissions. The products aren’t even used fully—as many as one-third of the hides produced are thought to end up in a landfill.

In addition to the environmental impact of greenhouse gas emissions and waste, it’s the process of tanning that is perhaps the most shocking. Considered one of the world’s biggest pollution threats, the tanning of [23 billion square feet](https://gizmodo.com/how-leather-is-slowly-killing-the-people-and-places-tha-1572678618) of leather a year directly affects an [estimated 1.8 million people](https://www.worstpolluted.org/projects_reports/display/88) through chromium pollution.

Tanning preserves the leather and makes it durable, protecting it against heat, cold, and water. It’s essentially an accelerated mummification process, beginning with the removal of hair, fat, and meat by physical scraping and using bleach and lime pastes. Then the leather is treated using a mixture of chromium salts and tanning liquor. It’s the cocktail of chemicals used that has a toxic effect: In total, about 250 chemicals are needed to soak, treat, and dye the leather.

The problem is that leather is usually processed in places with little environmental protection regulation, such as China, India, and Bangladesh, so the chemicals are [dumped into the environment](https://gizmodo.com/how-leather-is-slowly-killing-the-people-and-places-tha-1572678618); on average, tanning one ton of hide produces [20 to 80 cubic meters of toxic wastewater](https://gizmodo.com/how-leather-is-slowly-killing-the-people-and-places-tha-1572678618). As of 2021, the global leather industry was [valued](https://www.globenewswire.com/en/news-release/2022/08/22/2502449/0/en/Leather-Goods-Market-Size-is-projected-to-reach-USD-720-8-Billion-by-2030-growing-at-a-CAGR-of-6-2-Straits-Research.html#:~:text=The%20Global%20Leather%20Goods%20Market,the%20global%20leather%20goods%20market.) at $419.5 billion and is projected to reach $720.8 billion by 2030.

It’s not just the environment that’s in danger: People working in the tanneries are exposed to dangerous concentrations of the tanning chemicals, and they’re at risk of falls, drowning, and injury by the heavy machinery. Chromium is the most dangerous chemical they handle, causing a whole host of problems, from skin ulcerations called “chrome holes” to respiratory disease and cancer.

**Brewing Leather Like Beer**

Modern Meadow’s Andras Forgacs thinks there’s another way, and he’s bet [$53.5 million](https://www.crunchbase.com/organization/modern-meadow#section-funding-rounds) of venture capital on it.

“Animals are not just raw materials, they’re living beings,” he said in his 2013 [TED talk](https://www.youtube.com/watch?v=7gXq1ml6B1E). “Already our livestock is one of the largest users of land, fresh water and one of the biggest producers of greenhouse gases, which drive climate change. ... We need to move past just killing animals as a resource to something more civilized and evolved. Perhaps we are ready for something literally and figuratively more cultured.”

“We should begin by reimagining leather.” That’s how Forgacs proposes to shake up the industry—by culturing leather without the need for animals at all. Leather is essentially a simple material—one Forgacs and his team at Modern Meadow have spent the last few years working out how to grow through a process called biofabrication.

It’s not a new process; in 2007, Forgacs [co-founded Organovo](https://organovo.com/about/history/), a company that pioneered a technique for printing human tissue for medical use. With biofabrication, it’s possible to grow all sorts of tissues and organs, like windpipes, skin, and blood vessels, to implant into patients. Their work garnered a lot of attention, and Forgacs was soon approached about the possibility of creating animal tissue, particularly leather. He accepted the challenge and co-founded Modern Meadow in 2011.

Technically speaking, growing leather is simpler than growing human tissue, as there’s only one cell type to deal with. The secret is yeast: They alter the yeast DNA so the cells produce the protein collagen, the main constituent of leather. They ferment the yeast, much like in beer brewing, to grow billions of cells that produce collagen. Then they purify the collagen, which assembles into helices and fibers, forming the material’s structures.

The resulting leather is then tanned using a process with a smaller environmental footprint: “We preserve the material and then treat it to achieve the required suppleness and finish. Less water, less energy, less chemicals.” Modern Meadow’s [proprietary process](https://tinyurl.com/ycv44qth) reduces the time it usually takes to make leather—two years—to just two weeks.

**Looking to a Cruelty-Future for Animals**

Forgacs is excited, and rightly so: The process doesn’t harm animals, it uses fewer chemicals and there’s less waste. The leather can even be grown in the shape of a handbag or a shoe, helping manufacturers down the line to reduce their waste. They can also play with the properties of the material, making it thin and transparent or thicker and opaque, soft, breathable, and patterned—or a combination of these in a single piece of leather.

“This type of leather can do what today’s leather does, but with imagination, probably much more,” said Forgacs. Indeed, as the company responded to me in an email, “Biofabrication is still in its early stages, but the potential of the technology is massive.”

Modern Meadow’s materials brand, Zoa founded in 2017, hit the consumer market; its “reimagined” graphic T-shirt was a hit in a [fashion exhibit](https://tinyurl.com/y7b8fnl6) at the Museum of Modern Art in New York and was released in 2018. Dave Williamson, the company’s chief technology officer, [told The Atlantic](https://www.theatlantic.com/science/archive/2017/09/modern-meadow-lab-grown-leather/540285/) that the T-shirt “will change the way you think about leather.”

“Leather is a gateway material,” said Forgacs—a way to jump-start the biofabrication industry. There are already other applications on the horizon. [Bolt Threads](https://boltthreads.com/technology/microsilk/) is commercially producing engineered spider silk threads, with knit ties available to purchase. The company has also taken an alternative approach to leather: Its material [Mylo](https://boltthreads.com/technology/mylo/) is made by fungal mycelium cells that self-assemble into a leather-like material.

Think of all the other animal products we could eliminate using biofabrication. [Ceratotech](https://tinyurl.com/yaopd586) is “producing rhino horns without rhinos,” for example. “If poachers and consumers are just after the horn, and we’ve been able to create human tissue using genetic and stem-cell engineering, why shouldn’t we give this a try using rhinoceros stem cells?” [said founder Garrett Vygantas](https://pubs.acs.org/doi/full/10.1021/acscentsci.7b00592).

Then, of course, there’s the holy grail: meat. As a group of researchers from the National University of Singapore and Indian Institute of Technology in Hyderabad argued in a 2018 [paper in Biomanufacturing Reviews](https://link.springer.com/article/10.1007/s40898-018-0005-1), “Cultured meat or in vitro meat offers a safe and disease-free way forward to meet increasing meat requirement without involving animal sacrifices and at the same time, reducing greenhouse emissions, as compared to conventional meat.”

But as genetic engineering and biofabrication techniques continue to get cheaper and more accessible, it will be the hesitancy of the market holding back the commercial viability of lab-cultured meat: People might be willing to wear something grown in a lab, but eating it is another story.

As of 2021, the lab-grown meat industry is [valued](https://vegfaqs.com/lab-grown-meat-statistics/) at $130 million and is projected to grow to $500 million by 2030. Research shows that now over 80 percent of people in both the U.S. and the UK are willing to try lab-grown meat.

Modern Meadow released its first commercially-available product in 2020, and there’s a lot riding on its success: Zoa has had a big impact on the way the market perceives biofabrication in general. In February 2022, a study showed that Modern Meadow’s Bioleather1 material [produced](https://vegconomist.com/fashion-design-and-beauty/leather-alternatives/modern-meadows-bioleather1/) 80 percent fewer greenhouse gas emissions than bovine leather and synthetic leather alternatives.

As Forgacs predicted, the success of cultured leather has opened the door to a whole new world of lab-made products, ultimately reducing our reliance on livestock, the suffering of animals, and the impact on the planet.