



Fiber Spinning Reshapes Food Manufacturing Technology

For nearly a century, food manufacturing has advanced primarily through incremental improvements to ingredients and processes. Conventional technologies struggle to deliver the clean-label, nutritious foods with attractive textures that consumers look for. While refining existing technologies has yielded incremental gains, most producers still rely on equipment (such as extrusion systems) with structural limitations that constrain innovation in texture, sustainability, and ingredient diversity. Therefore, food manufacturing needs innovative technologies capable of converting a broad base of ingredients into delicious, nutritious, and affordable foods. Given the food industry's substantial environmental footprint, innovations that reduce emissions, conserve water, and protect biodiversity are increasingly prioritized.

With support from the U.S. National Science Foundation (NSF), Massachusetts-based Tender Food has developed a patented food fiber spinning platform that addresses these challenges by transforming diverse food ingredients into nutrient-dense, delicious, textured, and cost-efficient products. The energy-efficient platform, resembling an industrial-scale cotton candy machine, has demonstrated the potential to produce food at

throughputs exceeding 1,000 lb/hr. This is comparable to mid-scale extrusion systems, while offering enhanced flexibility and energy efficiency, at a fraction of the footprint and capital cost. Its modularity and simplicity enable low-cost, distributed food manufacturing across a wide range of applications.

At the core of this platform is rotary jet spinning, a patented physical process that generates microfibers from food ingredients at high throughput. In rotary jet spinning, a material solution is held in a rapidly rotating reservoir with small orifices on its side. Centrifugal force pushes the material through these orifices, stretching it into fine jets that solidify into fibers. For meat analogs, these densely packed individual fibers can recreate the complex fibrous textures characteristic of real meat, where traditional high-moisture extrusion technologies face persistent limitations, such as uniform or sponge-like textures rather than fibrous, layered structures. This technology unlocks the ability to create nutrient-dense texture from a broad range of ingredients without the use of additives, an advantage applicable to meat analogs and a broad range of snacking applications.

Tender Food has demonstrated this technology at pilot scale and commercialized its first application: a line of clean-label, whole-cut plant-based "meats" from shredded "pork" to "chicken breast." With NSF support, the company expanded its portfolio to include beef tenderloin, pork belly, and char siu pork. These can be entirely plant-based or blended with cultured animal

cells. NSF-funded research also confirmed that cultured cells can integrate seamlessly with plant fibers, providing a pathway toward blended products that more closely replicate the sensory features of meat. Recent U.S. Food and Drug Administration (FDA) approvals of cultivated meat products in the U.S. reflect growing regulatory confidence in these new alternative proteins.

However, further progress is needed to reduce costs and increase scale. Tender Food's "blended" product approach could help accelerate the pace with which high-quality products at low cost can be brought to market.

In addition to plant-based and blended meat analogs, Tender Food will soon be expanding into snack foods that benefit from protein and fiber nutrient density and clean labels, such as nutrition bars, chips, jerkies, candy, and more. The company intends to partner with food brands and manufacturers to use its technology to unlock better, cleaner products across these categories.

"The state of the art in food manufacturing technology largely hasn't changed for a long time," says Tender Food's Chief Scientific Officer Luke MacQueen. "By rethinking food manufacturing around fiber spinning, Tender Food has created a better solution from first principles, addressing both consumer demand and manufacturing challenges. Our technology can give consumers and manufacturers more of what they want — protein and fiber nutrient density, clean labels — and less of what they don't — sugars, binders, artificial additives — without compromising on texture or cost. We're replacing bad chemistry with good physics to create better food." **CEP**

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▲ Tender Food has created a variety of plant-based meat products, including (left) shredded pork, chicken, and beef; (middle) whole cut chicken breast, beef brisket, and whitefish; and (right) composite products like crab cakes and pork belly.

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