

Guide to skilled food extrusion

From ingredients to final products

The goal of feeding the world's rapidly growing population with affordable and sustainable food is a key driver in the food industry.

Developing sustainable food is about ensuring that the world's growing population has both sufficient food and access to high-quality, affordable, and nutritious food, while minimizing environmental impact and meeting customer expectations in terms of taste and texture. Sustainability includes trends such as plant-based proteins, and natural and functional ingredients that support health aspects.

Extrusion technology is considered one of the most promising platforms for the development of food products. It is widely recognized as an energy-efficient and environmentally friendly process. Extrusion enables a cost-effective, continuous means of production with precise control for maintaining high product quality.

Moreover, extrusion comprises a high range of adjustable process parameters that offer great flexibility to develop many different types of products. Extruders with varying dies are used to design and shape foods such as pasta, cereals, meat alternatives, and pet food, and to determine those foods' final textures.

The footprint and versatility of our small-scale extruders allow for the acceleration of application testing, process optimization, and material advancement. Unlike large-scale extruders, our instruments are designed specifically for these purposes.

Along with our worldwide demonstration labs, and our team of scientists from different disciplines including food extrusion, rheology, and electron microscopy, we have decades of application know-how and can assist you in realizing your specific sustainable food application goals. Talk to our experts today and learn what options are available to further your advancement in this innovative arena ([contact us](#)).

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This overview of the extrusion process introduces setups for producing High Moisture Meat Analog (HMMA) and texturized vegetable protein (texturized proteins).

Improving the texture of plant-based meats

Watch on demand this recorded talk from Dr. Valerie Stahl about improvements in extrusion texturization catalyzed by small-scale extrusion solutions.

Encapsulation of flavors and active ingredients using a twin-screw extruder

The benefits of twin-screw extruders for flavor encapsulation are outlined in this application note.

Confectionery process design with co-rotating twin-screw extrusion

Twin-screw extrusion technology is highlighted as an innovative means for the continuous production of confectionery products.

Benefits of starch-based twin-screw extrusion

The webinar included here explains how extrusion can be applied to influence the material properties of starch compounds. A video demonstrating how to make puffed starch-based snacks and cereal products using our lab-scale twin-screw extruders.

Enhancing juiciness in plant-based meat alternatives

Learn how tribology provides crucial insights about the ways oil content affects the mouthfeel and perception of juiciness in meat analogues

Food Resource Center

Comprehensive food development and testing solutions such as extrusion, spectroscopy, rheology, and more techniques support the development and production of foods. Find more information and support from our scientists.

Create a wide range of meat-like textures that consumers will enjoy

Twin-screw extrusion of plant-based meat

Overview

Twin-screw extrusion processing is considered a key technology for the continuous production of plant-based meat products. This application overview provided here demonstrates typical extrusion process setups for producing two different types of products: HMMA (high-moisture meat analogs) and texturized vegetable protein (texturized proteins). The main goal of this process is to impart a fibrous, muscle meat-like texture into plant protein-based formulations.



[View the application overview >](#)



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Flash talk: Extrusion of plant-based meat

Improvements in texturization through modular cooled-slit die design

While extrusion has become a cornerstone in the production of plant-based meat on an industrial scale, improvements in protein texturization are needed to keep up with consumers' expectations in terms of taste, mouthfeel, texture, variety, and affordability.

This talk from Dr. Valerie Stahl gives a brief overview of how our small-scale extrusion solutions have catalyzed remarkable improvements in the extrusion texturization of alternative proteins.



[View the video >](#)

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Enhanced flavor protection using twin-screw extrusion

Encapsulation of flavors and active ingredients

Flavors, fragrances, and bioactive food compounds are often supplied in powder or granulated form for easier handling and more accurate dosing in final products. Encapsulation protects against evaporation, oxidation, moisture, and other environmental factors, extending product shelf life and enabling controlled release of key compounds. While spray drying is common, its high temperatures limit its use with temperature-sensitive compounds. Twin-screw extrusion offers a modular, flexible alternative that requires no solvents, reduces floor space usage, and allows precise temperature control to prevent degradation, all while enabling customization of end products into various forms like pelletized powder or chill-rolled flakes.



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Combining multiple unit operations in a single piece of equipment

Confectionery process design with co-rotating twin-screw extrusion

The production of confectioneries is based on a series of molecular alterations of proteins, sugars, starches, and fats. Navigating these complex changes involves multiple process steps and demands the ability to precisely control each individual processing step.

Co-rotating twin-screw extrusion technology introduces an innovative approach to the continuous manufacturing of confectioneries. This method streamlines both the process and product development by minimizing the number of production steps, resulting in time and lab space savings.



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How extrusion conditions influence the properties of starch compounds



Benefits of starch-based twin-screw extrusion

Starch-based flours are a major food ingredient being widely used in the food industry for snack foods, cereals, and pet food products. Processing starch-based products with twin-screw extruders offers great flexibility in process design and properties of the final products derived from it. Choosing extruder parameters like screw and die design, processing temperature, and the liquid-to-solid ratio of the raw materials, enables the operator to greatly influence resulting product properties.



[Watch the webinar](#) that explains how extrusion can be applied to influence the material properties of starch compounds >



[View video demonstrations](#) showing how a lab-scale twin-screw extruder from Thermo Fisher Scientific can be applied to make puffed starch-based snack and cereal products >

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Enhancing juiciness in plant-based meat alternatives

Tribology reveals how oils enhance plant-based meat mouthfeel

The global shift toward sustainable food production has accelerated the development of plant-based meat alternatives. While replicating texture has become achievable through advanced extrusion techniques, mimicking the juiciness of conventional meat remains challenging.

Tribology, the science of friction and lubrication, provides critical insights into how oil content affects the mouthfeel and juiciness perception of meat analogues. By measuring the lubricating properties of extruded plant proteins, manufacturers can optimize formulations to deliver the sensory experience consumers expect.

Research shows that strategic oil incorporation significantly impacts both the structural integrity and surface properties of meat analogues, directly influencing consumer acceptance.



[Explore our application note](#) on confectionery process design, showing how twin-screw extrusion improves texture and consumer satisfaction. >



Food and beverage resources

Application laboratories

Our fully equipped application laboratories are in constant demand for testing customer samples and developing and optimizing pioneering applications. We provide a broad range of product and application solutions, and our team of application scientist and interdisciplinary technique specialists is on hand to answer your questions ([contact us](#)).

Register for application and product information at thermofisher.com/specoptin to gain access to latest resources to accelerate your research and improve laboratory productivity.

Seminars and trainings

Comprehensive training programs, in-house seminars, and practical rheology and extrusion courses in various locations around the world. We support our customers with comprehensive on-demand trainings (webinars, videos, and application notes) from our experts, benefit from our interdisciplinary knowledge in food science and technologies.

Food extrusion references

Want to discover more? Check out [our publications](#) on cereal and snacks, alternative proteins, and biodegradable films, all utilizing Thermo Scientific equipment to innovate alternative ingredients and foods.

 Learn more about food extrusion at thermofisher.com/plantbasedmeat and food rheology at thermofisher.com/foodrheology