THE FUTURE OF FOOD

TNO innovation for life

Printing a healthy snack that contains exactly the right amount of nutrients your body needs, without compromising on flavour and texture.

Science fiction? No, TNO can make this happen.

FACING THE CHALLENGES

With an increasing global population, the food industry around the world is facing a number of challenges, among them the rising demand for food. This requires not only more efficient food production but also improved food processing technologies. As resources become increasingly scarce, the reduction of both the carbon and water footprint of food products (especially dairy and meat products) has become a topic of great importance. As a result new food materials (e.g. originating from biotechnology) will emerge, requiring new processing technologies.

Finally, the demand for rapid product innovation means that production processes must be flexible in order to respond to changes in market demand. The food industry is often insufficiently equipped to handle these challenges as production tends to be based on classical processes. This is where TNO comes in.

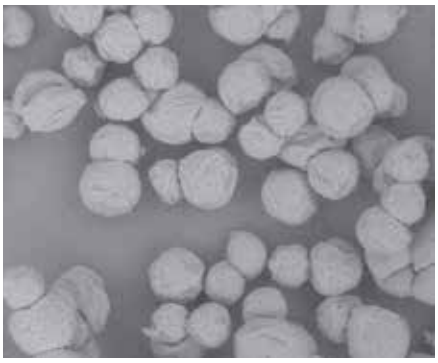
FOCUS ON INNOVATION

TNO develops various processing technologies that can provide a wide range of benefits to ingredient and food companies worldwide. TNO often does this by looking at principles and processes from other fields that can be adapted for specific food applications. TNO can help your company to increase efficiency, lower production costs, improve product performance and accelerate innovation.

VISIT OUR DEMO LAB AT
TNO.NL/FOODLAB

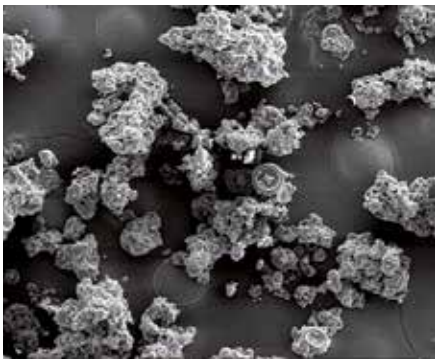
Controlled atomization

Well-defined cone of monodisperse droplets generated with TNO's 500 nozzle printing head



Well-defined powders

Maltodextrin powder produced with TNO's print-drying process (top) against a traditional spray-drying process (bottom)



OUR PRINTING PROCESSES PROVIDE PRODUCTS OF HIGHER QUALITY

POWDER PRODUCTION WITH PRINTING-DRYING

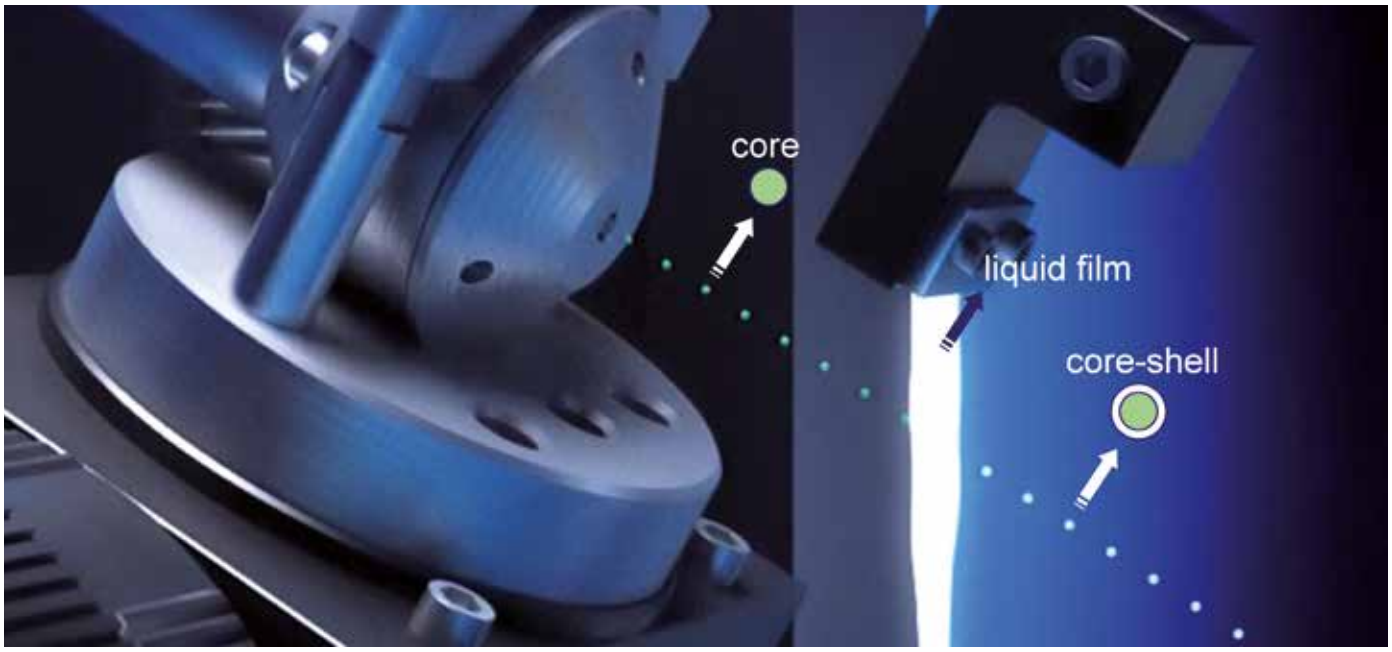
TNO's experience in 2D and 3D inkjet printing suggested that the ability to generate monodisperse droplets might be of interest to other sectors.
The high-viscosity jetting technology has resulted in the development of a new print head that provides an alternative to the conventional atomization technology used in spray dryers for food and other industries.

Based on inkjet technology, the print head produces highly monodisperse droplets, which transform into highly monodisperse powders after drying.
TNO currently has a 500 nozzle print head with a capacity of around 100 L/h and is investigating the development of print heads with an even larger capacity.

Although the current print heads can be fitted into existing drying set-ups, TNO is also working on developing alternative drying processes designed to maximise the benefits of the printing process.

The TNO printing-drying process has several distinct advantages over conventional spray drying processes, making it very attractive for various food (and pharma) applications:

- High energy and material efficiency
- Production of monodisperse droplets
- High solid content possible
- Adjustable powder properties
- Generation of high- density powders
- Low shear process
- No generation of fines



Encapsulation core business

Formation of 20,000 uniformly sized core-shell microcapsules per second by means of TNO's encapsulation printer

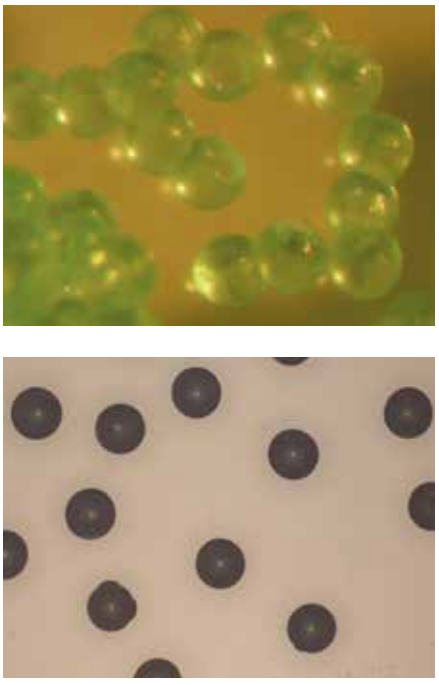
TURN YOUR LIQUIDS INTO SOLID WELL-DEFINED MICROCAPSULES

PRINTING MICROCAPSULES

By printing droplets of a core material through a liquid film of a shell material, core-shell microparticles (or microcapsules) are formed. The printing technology provides excellent process control, resulting in highly monodisperse microcapsules of adjustable dimensions with very well-defined shells of adjustable thickness. The process allows the use of a wide range of materials, including waxes and fats, polymers, aqueous (or other) solutions, emulsions and dispersions.

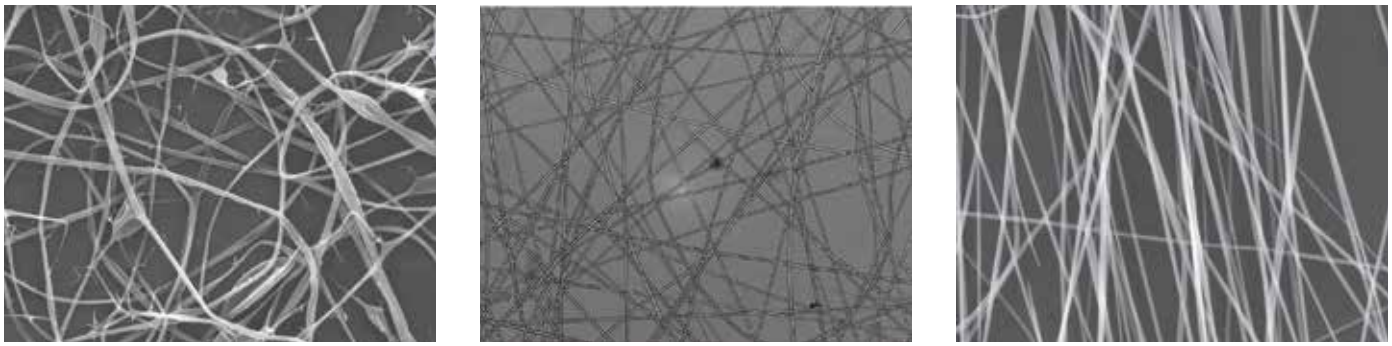
In addition, the separate streams for core and shell material prevent undesired interactions between the two and allow the use of different input temperatures. This innovative technology has great potential for various food, pharma and other applications.

Specific microcapsules and particles that have been prepared include flavor burst encapsulates comprising aqueous flavor and colorant solutions encapsulated in a wax; aqueous micronutrient solutions taste masked by encapsulating them in a shell of fat; oils encapsulated in a thin, food grade polymer shell; particle dispersions encapsulated in a food grade polymer shell made via coacervation; and calcium alginate gel particles made by printing alginate drops through a screen of calcium chloride solution.



High performance microcapsules

Highly monodisperse core-shell particles made with TNO's encapsulation printer.
Mint syrup core with a wax shell; Ø 200 µm
Linseed oil with carrageenan shell ; Ø 280 µm



A new class of food fibers

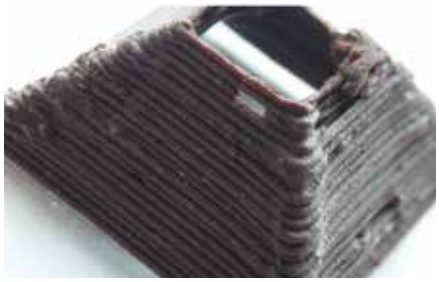
Randomly deposited fibers (Ø 0,1-0,2 µm) made of food polymers by means of electrospinning (left: the plant protein zein; middle: the carbohydrate dextran). Right image: example of dextran fibers deposited with directional preference.

SPINNING FOOD FIBERS

Fibrous materials in food products provide structure and texture that is essential to the overall organoleptic experience of a food product. The ability to adjust the properties of these fibres will open up new ways to create new or optimise existing food products. For this reason TNO has started the development of processing technology based on electrospinning that can produce well-defined fibres.
Ultimately, it will become possible to bulk produce fibres of a specific material composition, diameter, deposition direction and even fibre fragment length. Possible applications of such designer fibres include thickeners and texturisers as well as meat replacement products.

THE FOOD REPLICATOR

TNO foresees a future in which a wide variety of entire food products may be produced from a limited number of base ingredients using processing technology that can deposit and structure the ingredients in a highly controlled manner. By combining printing, spinning and various techniques from the field of Rapid Manufacturing we aim to create a food replicator technology that can initially be used for prototyping purposes but may ultimately be an addition to current food manufacturing processes. This will open up the way to highly personalised food as well as new food concepts not attainable using current production and preparation methods.



3D food fabrication

First examples of small food products made by means of Rapid Manufacturing techniques. Top: sugar objects made by selective laser sintering (25x4 mm); Middle: chocolate chain links made by SLS (20x10x2 mm); Bottom: hollow chocolate pyramid made with fused deposition modeling (0.5 mm wire).

TNO.NL

HEALTHY LIVING

TNO initiates technological and societal innovation for healthy living and a dynamic society.

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