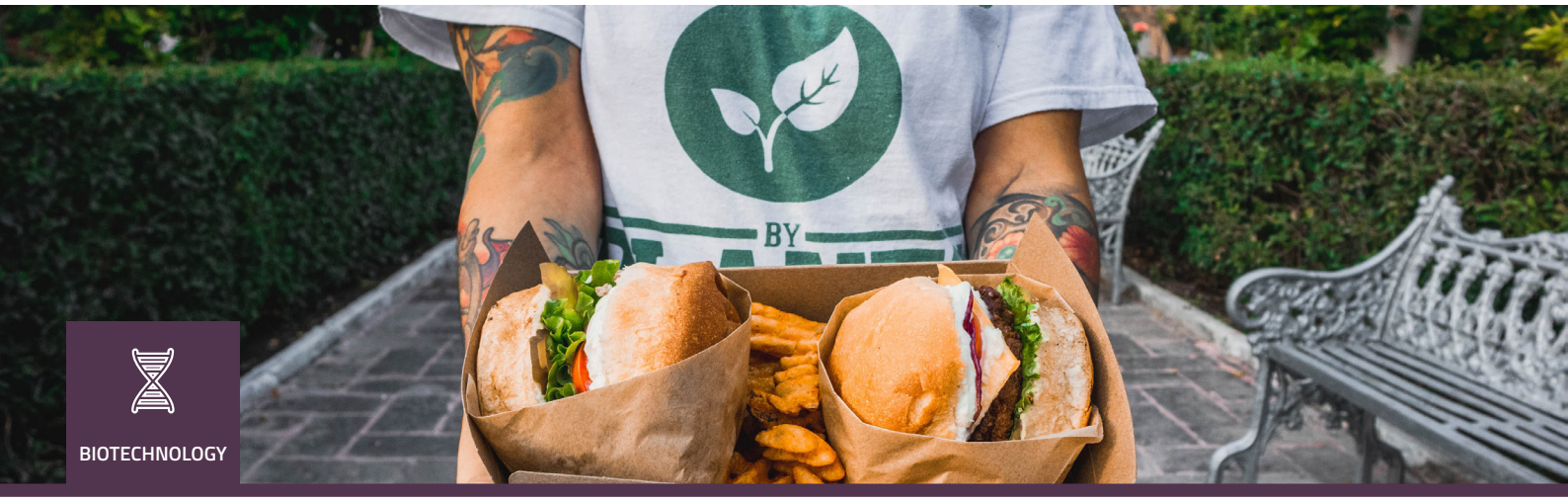

BIOTECHNOLOGY

# USING NEUTRONS TO IMPROVE MEAT ALTERNATIVES

**There is wide-scale concern about the impact of meat production on climate change due to associated land degradation, water consumption and greenhouse gas emissions. A shift towards consumption of plant-based meat alternatives could offer benefits for both the environment and human health.**

## THE CHALLENGE

To encourage consumers to switch to a more plant-based diet, meat-analogues would ideally be cheap and replicate the taste and sensory experience of meat. To achieve this requires an understanding how internal microstructures affect the macroscopic properties (texture, taste, etc.) of food.

## THE EXPERIMENT

To obtain a qualitative and quantitative 3D-understanding of food composite materials, several complementary characterisation techniques can be used. Often this includes microscopy or X-ray tomography. Less well-known (but just as valuable) are neutron techniques, such as Spin-Echo Small-Angle Neutron Scattering (SESANS), which can be used to 'look inside' the bulk of a food composite.

Scientists at Delft University of Technology and Wageningen University used neutrons to study two meat analogues: calcium caseinate and an anisotropic Soy protein Isolate-vital wheat gluten biopolymer blend.

## THE RESULTS

One study investigated the size and shape of air bubbles in calcium caseinate. Neutron techniques allowed a relatively large sample size to be probed, providing information on bubble width and deformation direction that agreed well with the same results obtained from the other techniques employed on smaller samples.

Another study was on the bulk and surface structure of the Soy protein Isolate biopolymer blend. Neutrons were able to determine the orientation distribution of the fibres and the number of fibre layers. The measured fibre thickness also confirmed results from another technique used.

**Fig 1.** To appeal to consumers, meat alternatives (e.g. seitan, made from wheat) need to look and taste like the real thing. Information from neutron scattering can help food producers emulate the texture of meat. Credit: Amy Stephenson.

> **A combined use of several characterisation techniques is necessary for better understanding of the nature of plant-based meat replacers as well as their functionality and structuring mechanisms.**
>
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> Delft University of Technology

WAGENINGEN UNIVERSITY & RESEARCH

TU Delft

# INDUSTRIAL APPLICATIONS OF NEUTRON SCIENCE

LENS LEAGUE OF ADVANCED EUROPEAN NEUTRON SOURCES

For decades, European neutron facilities have established productive collaborations with a diverse range of industrial users. Such partnerships have delivered important results for industry, providing insights into materials and methods that have driven process optimisations and technological innovations.

## WHY USE NEUTRONS?

### STUDY STRUCTURE

Neutron wavelengths are comparable to the spacings of atoms and molecules.

### STUDY DYNAMICS

Neutron energies are comparable to the time scales of molecular diffusion, vibrations and rotations.

### STUDY MAGNETISM

The neutron's magnetic moment can be used to study the microscopic magnetic properties of materials.

### PENETRATION POWER

Neutrons can penetrate deep into matter (including many different metals) enabling the study of large samples - even within complex sample environments.

### NON-DESTRUCTIVE

As a non-destructive, non-invasive probe, neutrons are suitable for the characterisation of delicate and precious samples.

### VERSATILE SAMPLE ENVIRONMENTS

Sophisticated sample environments enable measurements under operating conditions - including extreme temperatures, pressures, etc.

### SENSITIVITY TO LIGHT ELEMENTS

The neutron scattering power of nuclei varies in a quasi-random manner such that lighter atoms (e.g. H, Li) can be studied in the presence of heavier ones.

### ISOTOPIC CONTRAST

Neutrons are sensitive to different isotopes of the same element, so isotopic substitution (e.g. H/D) can be used to highlight specific structural features.

### COMPLEMENTARITY

Neutron scattering is highly complementary to other techniques, such as X-ray scattering, electron microscopy, magnetic resonance and computational methods.

## HOW CAN INDUSTRY USERS GET ACCESS TO NEUTRON FACILITIES?

European neutron facilities provide industrial users with access to advanced instrumentation for R&D. No prior experience is needed – expert scientific and technical staff provide support for users to get the most from their experiments.

Neutron facilities offer a variety of mechanisms to access their infrastructure, including proprietary access, academic partnerships and public beamtime.

**For more information, email contact@lens-initiative.org**