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Press Information TU Berlin at IFFA 2025 (English)

Creamy, crunchy, chewy and conscious plant protein applications: the Department of Food Biotechnology and Process Engineering (LBPT) of TU Berlin shares a digest of its' most recent research projects and results at this year's IFFA fair at the VDMA stand in hall 11.

Bringing animal and alternative proteins together in new processing schemes

The Department of Food Biotechnology and Process Engineering (LBPT) is divided into three overlapping and interacting working areas, covering a broad range of fundamental and application-oriented research topics: structure-process-functionality, food biotechnology, and bio-thermo fluid dynamics.

Development of innovative processes (e.g. for food preservation, ingredient functionalization, fermentation, extraction), optimization of conventional processes (including the development of resource-saving, sustainable processing methods, optimization of product quality through minimal processing) and mechanistic clarification of the effect of innovative and conventional processes on biological and food biotechnology systems are at the heart of LBPT's research goals. The research is based on the multiscale nature of food materials as a central element and aims to clarify, develop, refine and optimize processes with regard to safe, sustainable, functional and high-quality food.

Syntonizing nutritional and sensory value, the structure-process-functionality group researches processing methods and formulations, linking them to properties of innovative and sustainable food products. Different applications for and modifications of plant proteins and dietary fibers are main topics in this group.

With a focus on micro algae and innovative non-thermal technologies (pulsed electric fields, high pressure processing, ultrasound), the food biotechnology group investigates all biotechnological processes in food contexts from cultivation to downstream processing, food application and inactivation.

The bio-thermo fluid dynamics group deals with transport processes in flowable matter in biotic and abiotic matter. The particular challenge underlying this research is that simple conservation equation-based models are often not applicable, due to complexity of the variables and invalidity of assumptions like Newtonian rheology or continuum. Statistical methods, classification methods or cognitive algorithms are used to model the processes.

Elements of this research field overlap with food biotechnology, e.g. in the design of bio reactors or the processing chambers.

LBPT cooperates with industry partners (esp. small and medium sized enterprises) in many projects and bilateral cooperations to ensure high relevance and practical applicability of the results. Laboratory and in-silico experiments can be complemented by pilot scale processing in LBPT's technical facilities.

Verschiedene Brotaufstriche werden im Projekt Vegan Spreads untersucht und entwickelt.

Vegan Spreads – fermentation for clean-label formulations

From hummus and tomato-rocket to creamy herbs - vegan spreads are experiencing growing popularity in recent years and were already being bought by 52% of households in Germany in 2022. Combining the classical condiment with the plant-based trend, a new market for vegan spreads has evolved.

Many of the currently available products rely on high fat contents and additives like hydrocolloids to ensure a stable texture. From a consumer perspective, clean label products with short ingredient lists and high nutritional value are desired. Furthermore, unbalanced taste and texture profiles are often a challenge for plant-based formulations.

Addressing this gap, scientists from LBPT and the Meat Technology & Science of Protein-rich Foods (MTSP) group of KU Leuven (Belgium) are jointly researching how high-quality protein-rich spreads and cream cheese alternatives can be developed through fermentation with exopolysaccharide (EPS)-producing starter cultures (CORNET project Vegan Spreads; 01IF00364C). These specialized Lactobacillus strains positively affect the spreads' texture, mouthfeel, and ease of spreading by producing natural hydrocolloids in-situ during fermentation. In addition, they contribute to product safety and flavor by production of lactic acid and aroma compounds.

On the way to developing both a vegan cream cheese and a classic vegetable spread, the scientists investigate the optimal starter culture strain and fermentation conditions, and apply different innovative non-thermal processing methods (pulsed electric fields, static high pressure, ultrasound) to influence the microbial growth and product texture. To ensure a high consumer acceptance of the new spreads, a market study and a consumer survey are conducted. The aim is to create products that are tasty, plant-based, and healthy.

The results of the project will provide producers of spreads, but also dips, yoghurt, and cream applications with the required process knowledge to produce high-quality fermented products with a balanced nutritional profile and additive-free composition.

Vegan scaffolds for meat cultivation– combining bottom-up and top-down approaches

For producing meat on an industrial scale in a more sustainable, climate-friendly and ethical way, the cultivation of meat is considered a promising solution and as many as 26% of Germans can already imagine cultured meat as the nutritional solution of the future.

However, there are still many hurdles to overcome in order to become competitive with animal products in terms of both quality and price. At present, there is a lack of established processes for the production of food-compliant scaffolds that enable cultured muscle cells to adhere effectively, multiply and form complex meat structures. In a current IGF project (Vegane Stützstrukturen für Fleisch; 01IF22232N), scientists at TU Berlin (LBPT and Department of Applied Biochemistry) and TU Dresden (Chair of Food Engineering) aim to solve this technical challenge simultaneously in a top-down and a bottom-up approach.

In the top-down approach, porous or fiber-like structures are produced from protein-polysaccharide mixtures by extrusion and subsequent removal of one component. The resulting highly porous structures can then be colonized with chicken muscle cells. In the bottom-up approach, 3D-bioprinting is applied to create vascularized tissue-like structures, from which the muscle cells can then grow. By combining both approaches, the aim is to gain insights into the biocompatibility and phase behavior of the raw materials, the required porosity of the support structures and the cultivation conditions. The aim is to produce cultured meat products that correspond to the textures and structures of chicken fillet and minced poultry meat. Finally, a techno-functional and economic evaluation of the process will be carried out.

The results of the project increase the international competitiveness of local meat-alternative (and diversifying meat) producers, enabling them to expand their product portfolio by producing high-quality cultured meat products on an industrial scale through acquisition of biotechnological knowledge.

3D-printed strudtue and burger patties from press-cake-pea-mixtures: meat alternatives in top-down and bottom-up approaches are researched at LBPT.

Oil seed press cakes as meat alternative ingredients

Proteins from oilseeds, and in particular oil press cakes themselves, have so far played a subordinate role in the production of extruded meat substitutes (TVP). However, due to their nutrient composition and availability as a by-product, they have considerable potential as raw material in meat substitute production. In a IGF project concluded in 2024 (Ölpresskuchen für Kochextrusion; 21340N), this potential was explored in low-moisture extrusion of 15 different press cakes mixed with pea protein, and product development experiments (burger patties).

The TVPs contained 25 to 100% press cake, equaling min. 50% protein in the dry mix. Due to the elevated fat and fiber contents, press cakes reduce the expansion, hardness and cohesiveness of the TVP. While a higher hardness (i.e. firmer texture) of the TVP is desired if the goal is to imitate minced meat, the lower cohesiveness and expansion improve the texture so that the TVP is less spongy and rubbery.

In a model system it was shown that oil contents of 5% or more cannot be fully integrated into TVP structures and limit texturization. However, if native press cakes are used instead of separate oil and fiber sources, the maximum levels are higher, rendering them an attractive ingredient for TVP manufacturers.

In the course of the project, optimized extrusion conditions for texture and chemical stability of flaxseed, pumpkin seed and sunflower seed press cakes were identified to make the TVPs more meat-like while reducing off-flavors. Acrylamide and trans fatty acid contents were similar to or lower than in conventional soy products.

The knowledge gained in the project enables meat analog manufacturers to develop new products with press cakes. Using this residual material, companies can enhance the nutritional quality and sustainability profile at the same time. Oil mills (esp. small and medium sized enterprises focusing on cold-pressed oils) can increase the value of their by-product by shifting from feed to food application.

Looking into the future of food proteins

As the other projects show, numerous technological, social and institutional innovations are currently explored and industrially applied to change or replace animal protein in the diet. While the diverse negative impacts of conventional industrial animal husbandry are largely undisputed, the contribution of the alternatives to an inclusive, health-promoting and environmentally sustainable food system is often unclear or controversial. Growing market shares of plant-based alternatives indicate that we are already in the middle of a food protein transition. There is therefore an urgent need to comprehensively discuss and evaluate food protein innovations from a responsible-innovations-perspective. However, transparent methods and criteria for a comprehensive assessment are still lacking.

To tackle this transdisciplinary task, partners from the Berlin University Alliance (LBPT(TU) with Humboldt-Universität, Freie Universität, Zentrum Technik und Gesellschaft) have teamed up with multiple scientific and non-scientific stakeholders to better understand key environmental, ethical and equity aspects in the ongoing protein production transition and develop the necessary conceptual and methodological tools (Responsible Innovation for Protein Transition (RI-ProT)). The project will provide insights into the potential of different innovative solutions, and generate ideas for strategies, practices and policies to promote a just protein transition.