The aim of the Technofunctional Proteins (TeFuProt) innovation alliance is to develop in an environmentally compatible way new products with high earnings potential by using proteins from agricultural residues. As part of the alliance, the lubricant company FUCHS EUROPE SCHMIERSTOFFE GmbH from Mannheim will add modified rapeseed proteins as non-toxic additives to its product portfolio. The use of proteins from renewable raw materials contributes to the creation of a biobased, sustainable economy.

Proteins are used in many industries mainly in the form of enzymes. Consider the importance of enzymatic catalysis in the food, textile and detergent industries. A notable example is the subtilisin enzyme class which has been used as an additive for detergents since the 1960s; hundreds of tonnes of recombinant variants of this enzyme class are currently produced every year.

“The competition for the most effective enzyme variant is so great that in the intervening period patents have been filed for at least one mutation of each of the protein’s 269 or so amino acids,” says Dr. Esther Gabor, project manager Enzyme Discovery and Strain Development at BRAIN AG located in the city of Zwingenberg in southwest Germany. BRAIN is one of the leading companies in the field of industrial (“white”) biotechnology in Germany. The enzymes are usually obtained from microorganisms; for example, subtilisin was first produced with Bacillus subtilis.

Although proteins, enzymes apart, are one of the major building blocks of all organisms, they play a marginal role as industrial raw materials. This was not always the case. Historically, proteins from plant and animal sources played a major role in the chemical industry, for example as binders for dyes and as starting materials in the field of polymer chemistry.

Dr. Axel Höhling, CEO of ANiMOX GmbH and lead coordinator of the strategic alliance
Technofunctional Proteins (TeFuProt), pointed out that the synthetic plastic material galalith was developed more than a hundred years ago. It was made from the milk protein casein and used for the production of buttons, jewellery, and electrical goods such as radio casings. With the emergence of petrochemicals, materials like galalith have become less important. The TeFuProt alliance, which brings together 14 academic and industrial partners, has now set itself the goal of once again making proteins, which have long been forgotten and underestimated as renewable raw materials, suitable for technical applications.

Rapeseed as a source of technofunctional proteins

The Mannheim-based company FUCHS EUROPE SCHMIERSTOFFE GmbH, a subsidiary of the largest independent lubricant provider in the world, FUCHS PETROLUB SE, is part of TeFuProt, an alliance that receives 50% of its total funding of 9 million euros from the German Federal Ministry of Education and Research (BMBF). FUCHS produces and markets several thousands of lubricants for hundreds of applications. “Modified proteins can be used as lubricant additives, and they have a number of advantages over other additives,” says Rolf Luther, head of Test Fields and Advanced Development at FUCHS.

The cost of proteins is relatively low as they are found in large quantities in agricultural residues that cannot be used for food and feed production. Negative and toxic effects are unlikely. The physical and chemical properties (solubility, emulsification and flow behaviour as well as the ability to form protein-lipid films) of proteins vary considerably due to their amino acid composition. Since proteins consist of amino acids with hydrophobic as well as hydrophilic side chains, they can – in relation to their hydrophobicity or hydrophilicity – act as surfactants, solubilisers and dispersion enhancers. Amino acid modifications and substitutions can change the properties of the proteins.

The TeFuProt alliance uses plant storage proteins from oilseed residues, rapeseed in particular, as raw material. At the presentation of the project, Höhling stated that it had been calculated that the production of rapeseed oil leads to around 19 million tonnes of extract meals and press cake, of which around two thirds are used as animal feed. The remaining 4.5 tonnes, which are suitable for technical application, consist of around 40 percent usable protein. This corresponds to about 1.8 million tonnes per year, a huge quantity that has huge potential.

Bunge Deutschland GmbH, which is located close to FUCHS EUROPE SCHMIERSTOFFE in the Mannheim Harbour area, operates one of the largest oil mills in Europe with a rapeseed processing capacity of 1.1 million tonnes per year. Bunge is the largest processor of oilseeds and grains in the world. The alliance’s raw material is supplied by Bunge and processed by ANiMOX GmbH before being made available to the project partners. “If the project is successful, the alliance plans to establish a protein factory to supply its partners with the required quantities of modified proteins,”
From oil to renewable resources

By using a renewable raw material that is not used to feed humans and animals as protein source and by using biotechnological methods, the alliance contributes to the bioeconomy and to sustainability. Petrochemical products can thus be replaced by biobased products. Each individual project is evaluated in terms of its impact on the carbon footprint. Dr. Georg Schütte, Secretary of State at the BMBF, confirms: “The strategic Technofunctional Proteins alliance is an example of incentives that are working towards a transition from a fossil fuel-based economy to a bioeconomy based on renewable raw materials.” The alliance is funded under the German government’s “Industrial Biotechnology Innovation Initiative” which is part of Germany’s “National Research Strategy Bioeconomy 2030” for which over €2 billion have been earmarked.

FUCHS EUROPE SCHMIERSTOFFE GMBH is involved in three projects in the Industrial Biotechnology Innovation Initiative. Besides the TeFuProt alliance, the company is also involved in the ZeroCarbFP strategic alliance (see BIOPRO article of 6th October 2014, “Biobased lubricants with convincing technical properties”, link on the right-hand side) where it is working with BRAIN AG on the production of high-quality lubricant additives from biogenic raw materials and waste materials using enzymatic synthesis processes. The companies’ joint project “Advanced Biomass Value” is focused on isolating lipids from rapidly growing algae and turning them into high-quality lubricants. The remaining algal biomass is used to produce biokerosene using yeast. Any further remains are then incorporated into CO₂-absorbing materials. Therefore, no waste accumulates. Rolf Luther regards the participation of his company in these three projects as a huge success in itself. In addition, the
company’s participation in the projects opens up new access routes to different raw materials that ensure a stable, economically reliable supply”. With an eye on dwindling resources, this also makes economic sense.