

ALTERNATIVE PROTEIN SOURCES



TNO innovation
for life

All economic studies forecast that, in the coming years, there will be a worldwide protein shortage. This is caused by the increasing demand on protein by the ever growing world population. As an applied technology leader TNO is able to help food companies to search for tasty and nutritional alternative (vegetable) sources of protein.

Furthermore, emerging markets add their fair share on the growing demand for meat and dairy proteins. Often these type of proteins taste better, have high nutritional value, but they are less sustainable. On top of that, the demand for land, water, energy and other natural resources like minerals to produce these types of proteins are simply not available on our planet.

ESSENTIAL FOOD INGREDIENT

Proteins are an essential food ingredient for growth and development of children and essential for the maintenance of the health status of grownups. Consumers expect from food products with alternative sources of protein, excellent product performances in terms of taste, nutritional value, texture and convenience. TNO links the functionalities of renewable protein sources to physical properties like protein composition, solubility,

structure, denaturation and functionality and translates this with their expert knowledge to food applications including, bakery, meat, beverages or dairy. Protein functionality comprises of properties like emulsification, foam stability, water holding capacity and gelling strengths. Key to the value of alternative protein sources is functionality which is governed by maintenance of the integrity of the proteins at hand during the downstream processing. Here the adagio is mild processing and for this we have a number of units of operations available to preserve the economic value and the technical functionality of proteins during processing.

TNO'S UNIQUE TECHNOLOGIES IN PROTEIN RESEARCH:

- › Application in food / models: bread, meat, confectionary, beverages, dairy, sauces etc.

FUNCTIONALITY/STRUCTURE

- › Extraction/Isolation/purification
- › Structure-function relation
- › Modification
- › Ingredient interaction

POSITIVE EFFECTS

- › (tiny)TIM
- › Bioactivity
- › Satiety
- › Protein as carrier/encapsulation

PROTEIN STRUCTURE & CONFORMATION**ADVERSE EFFECTS**

- › Allergenicity
- › Digestibility (TIM)
- › Predictive models
- › New protein sources

PROCESSING

- › Selective separation: bio refinery
- › Innovative processing: SHS, UHP, rapid manufacturing, electrospinning, 3D-printing

NEW SOURCES FOR FUNCTIONAL PROTEIN

Alternative proteins could be extracted from various sources including; aquatic biomass like algae, sea- or duck-weed, agriculture crops like rapeseed, pea or canola, green biomass as in sugar beet leaves or green house waste or even from more unexpected sources like insects. Often this involves residual side streams of food process that still go unused in current production processes. TNO has a strong technology position, not only in the traditional whey protein valorisation in dairy for high end ingredients but is also active in the latest protein valorisation cases like potato waste and sugar beet leaves. The market for human protein consumption is interconnected with the animal feed markets. In the feed market too, similar challenges are at stake. Again it is worthwhile collaborating with TNO to replace e.g. less sustainable soy for the feed industry and make proteins available for the feed market at economic interest-ing cost, nutritional and safe.

CASE: ALGAE AS A PROTEIN SOURCE

Algae are a promising source of protein. These organisms contains many types of valuable ingredients, grow very rapidly, and can be cultivated and harvested in relatively simple ways. This is why they are sometimes attributed as the agricultural crop of the future. Moreover, to make a sustainable business case all ingredients must be utilized. Functional and nutritional algae-protein is the engine of the valorisation pyramid. Thus, all these valuable ingredients must be extracted from the algae in just the right way preserving value and functionality.

Using innovative cell disruption technology, TNO has managed to break open algae with a very tough cell wall in a mild and energy efficient way. This is an important step in the cascading biorefining process to generate profitable applications for algal ingredients for food, feed and non-food applications. In the context of the GAIA (Getting Algae Ingredients Applied) consortium TNO is working on developing various applications for algae ingredients, in partnership with algae producers and end-users. Currently, the algal ingredients are produced on a pilot scale, for the purpose of application testing. TNO builds a mobile bio refinery pilot that is capable of processing relevant qualities of biomass, including algae and obtain functional protein as well as other relevant ingredients e.g. poly unsaturated lipids, pigments, carbohydrates and phytochemicals.

CASE: PROTEINS FOR THE DEVELOPING COUNTRIES

TNO takes her social responsibility and is dedicated in its concern of feeding the developing countries with enough, safe and nutritional protein. That is the reason why TNO is leading the project known as 'flying foods'. In this program we help the poorest farmers at the base of the pyramid in Kenya and Uganda with a local, inexpensive and manageable source of nutritional protein. In this project we makes use of insects as a new source of functional, tasty and nutritious protein. In this way we secure the essential food supply of these farmers and their families. Developing countries and emerging economies offer

an enormous consumer and producer market, and western food producers and industries increasingly realize the necessity to be present in these countries. The idea of African and Asian countries as needy and incompetent is past, investors and industry will contribute to solving the global food security issue and make significant profits. Inclusive innovation also in these countries is crucial in providing enough, safe and healthy foods for the future.

TNO.NL**TNO HEALTHY LIVING**

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

TNO
Utrechtseweg 48
P.O. Box 360
3700 AJ Zeist
The Netherlands

Mr. Maurits Burgering
P +31 (0)88 866 50 95
E maurits.burgering@tno.nl

North America
Mr. Mark Posno
P +1 617 916 52 38
E mark.posno@tno-na.com