

ENJOY HEALTHY FOOD WITH CONFIDENCE

TNO innovation
for life

RESEARCH PARTNER IN
FOOD AND NUTRITION



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The world needs healthy, safe and sustainably-produced food products more than ever. Within the framework of national and international legislation, the agrifood sector launches over 15,000 product innovations a year. TNO develops methods and produces research insights that enable innovation.

INNOVATIONS IN HEALTHY, SAFE AND SUSTAINABLE FOOD

The food industry is facing enormous challenges. Today's large-scale food production negatively impacts our environment, and raw material supplies are becoming exhausted. Population-associated pressures on our planet will increase substantially in the next decade, and the number of people with obesity, diabetes and food allergies is on the rise. As globalization speeds up, the risk of unmanageable food incidents increases correspondingly.

TO ACCELERATE INNOVATION

These developments require innovations in healthy and sustainably-produced food products, and a rigorous risk-management approach. TNO meets these demands through its multidisciplinary research programme. The organization develops methods and delivers insights that help the agrifood sector to innovate quickly and that support

governments in policy development. With its broad knowledge, experience and expertise, TNO has an important role to play in the translation of fundamental scientific insights into innovative, tailor-made applications. TNO is a partner in several public-private partnerships (PPPs) and open innovation networks in the Netherlands and the European Union.

TNO RESEARCH PROGRAMME

This particular TNO research programme has three research areas. Food and Health develops methods for short-term assessment of the health effects of food products. In Food Innovations, TNO is developing a comprehensive approach that allows manufacturers to significantly shorten time-to-market for healthy and sustainable innovations. The research area focuses on issues of product formulas, production processes

and product quality. The final research area, Food Safety, develops methods for efficient safety assessment and risk management. The research area focuses on issues of complex food matrices, allergenicity, emerging risk identification, in-line detection and controlling microbiological safety.

› FOOD SAFETY

› FOOD AND
HEALTH

› FOOD INNOVATIONS



FOOD AND HEALTH

In today's market, knowing the health effects of your products is essential. Whether you supply a unique product to a specific sector, or put bread on every breakfast table, consumers, retail partners, health professionals and other stakeholders will ask about health.

When food and health is the issue, TNO is your trusted partner providing:

- Short term: regulatory consultancy on claims and scientific communications.
- Medium term: unique array of model systems, and human clinical trials.
- Long term: (co-financed) research partnerships.

INNOVATIVE ASSESSMENTS OF HEALTH EFFECTS

TNO combines academic excellence, CRO expertise and knowledge of international markets and policies. Our ambition is to play a leading role in the development of healthier food products and concepts, in order to benefit society. To achieve this goal, we have given each of our innovative research programs a specific focus.

MEASURING HEALTH

TNO has developed an innovative concept to define and measure health. Several challenge-tests have been developed to measure the body's ability to cope with external stressors: the more resilient, the healthier. Modern 'omics' techniques are indispensable to evaluate the often subtle effects of food on health parameters. One important goal is to define new biomarkers for health and disease. This technique opens up many new possibilities for the

investigation and communication of health effects.

GASTROINTESTINAL HEALTH

More and more is known about the influence of the GI tract on health and well being. TNO is exploring this field using a unique set of expertise and tools. Our proprietary family of in vitro gastrointestinal models (TIM) gives TNO a significant advantage in this research. TIM can be combined with a broad array of in vivo, in silico and in vivo models, metabolomics techniques, and challenge-tests in humans. Key research directions include the effect of intestinal microflora metabolites on weight management and appetite, and the relationship between nutrition, intestinal-barrier function and the immune system in relation to chronic inflammation in fat tissue.

NUTRIENT SENSING

Macronutrients are detected by our body and generate regulatory responses including the onset of digestion and regulation of prospective food intake. TNO is collaborating in an academic and industrial network, identifying new physiological and molecular targets - and new approaches - to nutrient sensing, which can be used to optimize body-weight regulation. Currently, the focus is on the small intestine. For the food industry, this project will give insight into formulating functional foods for weight management. This is relevant for serious public health problems such as obesity and for patients dealing with anorexia and disease-related weight loss.

› REWRITING THE DEFINITION OF HEALTH

› DETERMINING SUBTLE HEALTH EFFECTS OF VEGETABLES

› RAPID IN VITRO ASSESSMENT OF PROBIOTIC SURVIVABILITY



FOOD INNOVATIONS

Product development and reformulation can be very challenging. Changes in a product formula or recipe should maintain the product's desired qualities of flavour, texture, shelf-life and safety. Moreover, product quality should go hand in hand with efficient and sustainable production processes. TNO's comprehensive approach to advising manufacturers enables them, in a faster and in a more efficient way, to introduce new and improved products that meet the demands of today's markets.

SOLVING DEVELOPMENT ISSUES EFFICIENTLY

TNO works with a comprehensive approach that empowers ingredient suppliers and food manufacturers to efficiently solve issues of product development and reformulation.

Clients can then significantly shorten time-to-market for new and improved products. TNO's method dynamically acquires and seamlessly integrates knowledge of ingredients, production processes and product quality. New insights into ingredient interactions provide leads for the optimisation of production processes and improvements in product quality.

TNO makes an important contribution to targets set by the government and industry for reformulating existing food products into healthier equivalents and for creating a sustainable and secure food production chain. The organization is partner in several national and international open innovation

networks. The ambition is to make sure that improved products are launched quickly and successfully on the market. The research programme follows three interdependent paths.

QUALITY

TNO solves quality issues that arise from reformulation in particular addressing the salt, sugar and fat content of products. Both experimental and predictive modelling tools are available to maintain product characteristics. TNO also investigates new ways of using ingredients to structure products such as mimicking the texture of meat with vegetable proteins.

INGREDIENTS

TNO has IP protected technologies for food production and modification that creates 'greener', 'cleaner' and healthier ingredients and innovations

in this area. Ultimately, this provides label friendly solutions for ingredients such as modified starches. Other ingredient innovations include protein formulations for improved oxygen and water barriers and healthy fibres from wheat and other sources with excellent textural properties.

PROCESSING

TNO develops separation, drying and production processes that are energy efficient, reduce waste streams and improve product and ingredient quality. Examples include drying techniques such as Super Heated Steam (SHS) and inkjet spray-drying. In addition TNO uses novel processing methods such as electrospinning and rapid manufacturing to create completely new ways to produce structured food products.

› PRINTED
WINE-GUMS

› 40% SALT
REDUCTION
IN BACON

› ALGAE-BASED
MEAT
SUBSTITUTES



FOOD SAFETY

Efficient (food) safety assessment is becoming more and more challenging. Product constituents are growing in number and variety. For many substances the toxicological hazards and the allergy-causing potential are unknown. Negative health effects of components often manifest with a delay, and evaluation of emerging food risks is difficult due to lack of data. TNO supports manufacturers and governments by developing advanced methods for (food) safety assessment and risk management.



EFFICIENT SAFETY ASSESSMENT

TNO is a world leader in (food) safety assessment and risk management, developing methods that allow manufacturers and governments to obtain rapid insight into the risks of complex products. In addition, TNO's work on food allergy should deliver more efficient assessment protocols and better understanding of factors determining allergenicity. As a partner in several programmes for (open) innovation, TNO is also developing instruments for early detection of emerging public health hazards to prevent food crises.

The ambition is to create a set of internationally-acknowledged assessment methods that accelerate product and policy development and increase accuracy, while reducing emergency response times for emerging food incidents. TNO is following five research approaches.

COMPLEX FOOD MATRICES

TNO develops methods for the toxicological safety assessment.

These include tools that measure concentrations of unknown compounds and that enable exclusion of (geno)toxicity. Examples include physical-chemical screening methods and (microbial) genomics techniques. These methods are integrated into a safety assessment strategy.

ALLERGENICITY

Together with partners, TNO develops biological and physical/chemical tools to predict, understand and prevent allergenicity of proteins and peptides, which are then translated into a risk assessment strategy. Examples are an innovative probability-based method that enables assessment of food allergy risks and a large database on allergic responses.

EMERGING RISK IDENTIFICATION SUPPORT

TNO has developed a unique and cost-efficient Emerging Risk Identification Support service (ERIS) to identify and evaluate present and

emerging safety risks. ERIS helps to anticipate food and feed safety crises and issues and enables stakeholders to develop appropriate risk management strategies at an early stage.

IN-LINE DETECTION

TNO has developed a unique, tailor-made detection strategy that enables food manufacturers to monitor product safety, quality and authenticity in line. On request TNO develops in line sensors, process and packaging control systems and non-invasive detection equipment.

CONTROLLING MICROBIOLOGICAL SAFETY

TNO offers tailor-made solutions for complex microbiological issues related to safe and high quality food products and food processing systems. TNO's new protocols and analysis methods help the industry improve the microbiological safety of food.

› IDENTIFICATION
OF MICROBIAL
OUTBREAKS

› ALLERGY
INFORMATION
GUIDELINES

› MANAGE NEWLY
FOUND RISKS

TNO IN BRIEF

Our world is changing fast. Developments in society are radical and often intangible: ageing, climate crisis, energy and raw material depletion, and security issues that demand measures to secure the foundations of our society for the long term. These challenges also bring opportunities: they require for innovations, new technology and a new way of thinking.

A RELIABLE KNOWLEDGE PARTNER

TNO was founded during the economic crisis of the 1930s, based on the conviction that new knowledge and technology is vital to economic growth and social renewal. Such investment is crucial in times of crisis. These principles are now more pertinent than ever.

TNO has supported government and industry with science, knowledge and innovation. Initially as a government-

funded research institute and, more recently, as a modern application-oriented innovator. Our vision of the future centers on a society that provides prosperity and welfare for all. A society in which competitiveness and sustainability go hand in hand, as we move forward together. TNO sustains progress by applying scientific knowledge to solve the complex issues confronted by society, and using innovation to boost the competitiveness of industry. The same qualities that founded TNO still power our work today: knowledge, creativity, curiosity and idealism.

TNO's strength lies in our ability to combine diverse scientific expertise to create pioneering solutions: in global partnerships with government, industry and relevant knowledge institutions and NGOs. Over 4,000 TNO scientists, researchers and specialist support staff, in multi-

disciplinary teams, support our vision.

TNO APPROACH: FOCUS ON SEVEN RESEARCH THEMES

TNO wants to make a real difference: to generate solutions that address key issues in society. We have therefore chosen to focus on seven research themes of global significance that require new, creative, comprehensive solutions. Themes that match the pressing issues of government, industry and the knowledge infrastructure. The seven themes are:

- Healthy Living
- Defence, Safety and Security
- Transport and Mobility
- Information Society
- Industrial Innovation
- Energy
- Built Environment

› NEW CREATIVE SOLUTIONS

› CLIENTS ALL OVER THE WORLD

› SCIENTIFIC EXCELLENCE

› ENJOY HEALTHY FOOD
WITH CONFIDENCE



› **HEALTHY LIVING**

TNO initiates technological and social innovation for healthy living in a vital society.

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› **MORE INFORMATION**

If you are looking for solutions or want to receive more information on our research services, please contact our sales department at:

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