

# FOOD AND NUTRITION UPDATE



**TNO** innovation  
for life

## TNO ACCELERATES FOOD INNOVATION

Product quality, sustainability and food security are key elements in the TNO Food Innovations research program. At the 2013 Food Ingredients Europe (FIE) exhibition, 19-21 November in Frankfurt, the knowledge institute will share its latest highlights and goals with the industry. "Our international partners benefit from easily-accessible knowledge and practical support to develop high quality food ingredients and products, using sustainable processes", say TNO representatives Joost Blankestijn and Ronald Visschers.

"Three main forces - sustainability, informed consumers and dynamic markets - are calling for innovation from the food industry", says Joost Blankestijn, Business Development Manager Food Innovations at TNO in Zeist. Developing innovative food products is, however, a challenging task. "Product development and optimization bring many issues. How do you reduce sugar, salt or fat levels or use an alternative protein source in your product without compromising taste, texture, shelf life and food safety?", he explains. "Today, high quality foods should go hand in hand with efficient and sustainable production processes."

### TO SHORTEN TIME-TO-MARKET

With its food innovations research program, TNO supports manufacturers in the development of new and improved food products, focusing on shortening time-to-market and increasing the chances of success. "We help food and ingredient producers to tackle the complex issues they encounter in the innovation process and to translate these issues into practical solutions", says Ronald Visschers, Business Line Manager at TNO in Zeist. "In our work we combine fundamental scientific insight with a hands-on approach. Extensive analysis and technology platforms are available, for example microbial genomics tools, food physics methods, pilot production facilities and additive manufacturing technologies. This is what makes us unique."

TNO is internationally acknowledged for the breadth of its expertise which ranges from ingredients and model applications to microbiology and process technology. The organization provides solutions to obtain ingredients with improved functionality through novel production processes, products with extended shelf lives and consumer-friendly labels. Other solutions include new mild and/or natural preservation strategies and sustainable processing technologies. "Sustainable processing, for example, could be 3D-food printing, but also advanced separation techniques for creating additional value from waste streams and for optimal exploitation of alternative protein sources", Visschers explains.

#### FROM MULTINATIONAL TO SME

TNO collaborates with partners all over the world (See Textbox). "Get Algae Ingredients Applied (GAIA) and Multiple reformulation, for example, are projects co-financed by consortia of between five and ten manufacturers with similar interests and goals", says Blankestijn. In both consortia, small and medium sized enterprises (SMEs) and multinationals work side by side together with TNO to achieve the desired results. GAIA is targeted at obtaining ingredients from algae that can be used in foods, whereas *Multiple reformulation* aims to reduce sugar, salt and fat in a broad range of food products.

"In addition, early in 2014, we will establish a *Clean-label* consortium with representatives from the whole production chain", Blankestijn continues. "We aim to create a framework that guides the industry in deciding whether a product is clean-label or not. From there, we will work towards clean-label products by replacing, eliminating or modifying 'unclean' ingredients for every project partner." Manufacturers can still apply to participate in this consortium.

Visschers mentions another interesting project, *Performance*, funded by the European Union. "This project will develop products for elderly with swallowing problems - an issue that often results in under- and malnutrition. TNO's 3D-printing technology will be used to produce foods personalized for this group of people."

#### MEETING CUSTOMERS

An update of all current and impending TNO projects, including a live demo of 3D-printing, will be presented at the 2013 Food Ingredients Europe exhibition, in Frankfurt (Booth 8.0 B87). "We will be delighted to meet our customers, in person, and discuss how we can support them in their innovation processes", says Visschers. On Tuesday 19 November, TNO will organize a dinner for its customers, during which a presentation will be given on how the organization might

assist food and ingredients factories in Germany.

Would you like a seat at the dinner table? Or would you like to meet a specific TNO representative on the stand? Please contact Joost Blankestijn, +31 88 866 16 93, joost.blankestijn@tno.nl

#### COLLABORATION WITH TNO

Food ingredient suppliers and food manufacturers can make use of TNO's innovative power in different ways:

- › one-on-one collaboration via contract research projects;
- › participation in international projects funded by the European Union;
- › participation in (often national) co-financed projects, together with TNO and other food and ingredient companies;
- › participation in regional research programs, funded by particular Dutch and German provinces (for example INTERREG and FoodFuture);
- › Tailored TNO SME programs.

## TNO PART OF LARGEST-EVER FOOD ALLERGY PROJECT

Recently, the integrated Approaches to Food Allergen and Allergy-Risk Management project (iFAAM) was launched. It is the world's largest research project into food allergies. iFAAM is funded by the European Commission and will produce risk-based strategies for allergen management in food manufacturing facilities. TNO is coordinating a specific work package addressing the risks from allergens present in food products due to unintentional cross-contamination.

Up to 20 million European citizens suffer from food allergies. However, management of both food allergies (by patients and health practitioners) and allergens (by industry) is hampered by the lack of risk-based strategies for preventing food allergy or for adequately protecting those with existing allergies.

#### TRUSTWORTHY MAY CONTAIN LABELING

An international, TNO-coordinated, team of researchers will produce reference doses for allergens highest on an EU list of allergens, using clinically-derived threshold information from food allergic individuals, and combine it with European food-product consumption patterns.

Further, TNO is developing allergen cross-contamination scenarios for the most important production processes. This collaborative effort will lead to an approach for risk assessment and risk management based on knowledge



# DETECTING EARLY SIGNALS OF FOOD CRISES VIA ERIS

TNO'S EMERGING RISK IDENTIFICATION SUPPORT SERVICE

Is it possible to prevent a new melamine crisis or similar food-safety catastrophe? TNO's Emerging Risk Identification Support service (ERIS) brings the food industry much closer to the prior identification of potential hazards and incidents, by identifying early signals that point in a particular direction. ERIS then makes it relatively simple, if the necessary knowledge and creative thinking are present, to build future scenarios for possible food safety hazards.

The contamination, in China, of infant formula by melamine hit the headlines a few years ago; an issue with a dramatic impact on infant health and a worrying surprise for the food industry. Many monitoring systems and rapid alert mechanisms are in place to react to incidents and signals that imply a possible issue. However, to protect the consumer and the food industry, the real challenge is to have pro-active systems in place that gain time or prevent crises



by identifying the earliest possible signals.

Experience confirms that almost all such crises have precursors, early signs that something is amiss. For example, the Chinese melamine crisis was preceded by a 'signalling' incident, a year earlier, when pet food was contaminated by melamine with the same intention and originating from the same geographical region.

## BIG DATA MINING

ERIS is the first system to support early and advanced identification of emerging

hazards and issues, based on in-depth studies of the early signals of historical food safety incidents. The system mines big data sets for early signals and (unexpected) relationships between different sets of information. The ERIS approach combines high-precision searching with TNO's existing food safety intelligence to examine every possible combination of food products, hazards and adverse health effects.

## POSSIBLE ISSUE

A recent application of ERIS indicated the following potential problem: early reference to a possible mutagen formed during the production of omega-3 fatty acids as food ingredients. The substance, 4-oxohexenal, has since been identified in a few follow up references indicating links between an adverse health effect and its presence in food. Is this a potential issue, given that consumption of omega-3 fatty acids are on the increase?

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## PROJECT

previously developed by TNO and knowledge developed in iFAAM. Ultimately this should create a standardized allergen-management process for food manufacturers, provide clear guidance for food-allergen labeling, and reduce the number of products with ambiguous may contain food-allergen warnings.

The final results of iFAAM will contribute significantly to improving the current practices in allergen and allergy management of cross-contamination in food-manufacturing facilities.

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# THE DO IT YOURSELF TRIAL

MAKING HUMAN INTERVENTION STUDIES MORE ACCESSIBLE

TNO is developing a unique approach for human intervention studies: the Do It Yourself (DIY) trial, with test subjects doing their own health measurements, at home. The new approach would cut-down the cost of human intervention studies and increase the significance of results. A DIY study has been designed to show that the new format allows for an 'EFSA-proof' human intervention.

The human trial is an important step in the, often protracted, process of proving the health effects of nutrition and lifestyle interventions. Performing a proper intervention study is expensive

and, amongst other costs, you need to employ professionals to do on-site measurements and to guide the test subjects throughout the study period. Moreover, you have to meet strict regulations when submitting a health claim for approval by the European Food Safety Authority.

## SAVING TIME AND COSTS

In the novel DIY trial approach that TNO is working on subjects will do most, or even all of their measurements, themselves, at home, using a smart phone or a custom-built device. This saves food manufacturers both time and cost: you no longer need to pay for the use of a clinic or to hire professionals to perform measurements there. The approach also gives information about consumer

# NEW INSIGHTS FROM TRANSLATIONAL RESEARCH

## TNO'S APOE\*3 LEIDEN MICE OFFER VERSATILE POSSIBILITIES IN DIETARY HEALTH RESEARCH

TNO's in-house developed ApoE\*3 Leiden mouse model has a virtually unparalleled track record in the study of cardiometabolic health, addressing a range of dietary, lifestyle and pharmaceutical interventions. More recent studies have revealed the value of the model, which carries a human defective ApoE gene, in investigating brain health and host-microbiome interactions.

The ApoE\*3L mouse is characterized by impaired lipoprotein clearance from the plasma and expression of human-like LDL plasma profiles on high-fat, high-cholesterol diets, similar to humans. Following extended growth on such diets, the mice develop atherosclerosis and show features of mild metabolic syndrome. Interestingly, various drug intervention studies have demonstrated that plasma profiles for various disease markers in

this mouse model show similar responses to those found in humans. Hence, the translational value of results from studies with ApoE\*3L mice is high. By using various read-out methodologies, application of the model has led to in-depth knowledge of the physiological processes and metabolic switches that play a role in the gradual shift from health to disease and to understanding how diet or drugs can be used to reverse the shift, or to reduce disease complications.

### DIETARY MODULATION

Recent TNO studies using ApoE\*3L mice confirm that the development of cardiovascular disease can be modulated by dietary strategies. For example, a multicomponent mixture of anti-inflammatory ingredients was reported to effectively prevent development of atherosclerotic plaques, an early-stage marker of cardiovascular disease (Verschuren et al. 2011). Another study showed prevention of overweight upon early administration of the long-chain fatty acids arachidonic

acid (ARA) and docosahexaenoic acid (DHA) in mice (Wielinga et al. 2012). Other studies include evaluation of the effect of probiotics on inflammatory processes, of resveratrol on insulin resistance and of chocolate extracts on lipid metabolism.

In current research programs, TNO is using the model to study the relationship of dietary strategies and healthy brain development and to unravel host-microbiome interactions under various dietary regimens.

Increasingly, systems biology designs and technologies are being applied to reveal the underlying processes and to identify relevant physiological switches which could be targets for dietary strategies. In this field, TNO is recognized for its wealth of know-how, exemplified by use of the ApoE\*3 Leiden mouse as a unique translational model in combination with suitable dietary strategies.

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behavior in real life situations: how and when does a person consume specific foods at home? If and how is someone applying exercise and personal lifestyle advice on a day-to-day basis?"

The DIY trial can be applied to a wide range of research questions, such as how nutrition and lifestyle affect blood glucose, blood pressure, satiety, aspects

of metabolic health, gastrointestinal parameters, mood or sleeping patterns. TNO has tested different self-monitoring devices for their applicability in the DIY trial.

### RELIABLE

Although with the DIY trial the physical distance between researchers and test subjects usually increases, the DIY trial is no more sensitive to bias than any other intervention study conducted on location. In contrast, this type of research might motivate test persons even more to perform at their very best, because they can participate to the study while they are at home. This will increase reliability.

### PILOT STUDY

TNO has designed a pilot DIY study with caffeine as intervention and cognitive performance as readout, in order to

demonstrate that the format allows for an 'EFSA compliant' intervention. Subjects will assess effects on concentration and alertness at home, using an internet test. TNO human physiologists and psychologists with experience in cognitive performance testing have been involved in the study design and execution. Several food companies are collaborating in the project.

### FULL-SERVICE PACKAGE

The caffeine demonstrator study is the first in a series of studies using the new approach. Follow up studies will be set up with more complex designs, interventions and read-outs of body functions. TNO aims to launch the DIY trial within two years, as a full service package for the industry.

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## FOOD INSPIRATION DAYS

TNO COLLABORATES WITH CAS SPIJKERS ACADEMY

At the 2013 Food Inspiration Days, held 21 and 22 October in Eindhoven, TNO presented a range of high quality, delicious dishes made using advanced 3D food printing techniques. To prepare the dishes, TNO employees worked closely together with students from the Netherlands' top culinary institute – the Cas Spijkers Academy.

The collaboration with the academy, where the Michelin-starred chefs of the future are being trained, arose from TNO's successful participation in last year's Food Inspiration Days event, where its live demonstration of food printing, following by a taste session, was



received with tremendous enthusiasm. Michelin 3-starred chef Sergio Herman commented that the “work looked very impressive, but that flavors could be improved.”

### WORKSHOPS AND COOKING SESSIONS

For this year's presentation, TNO took Sergio Herman's advice to heart and teamed up with the Cas Spijkers

Academy. In a number of workshops and cooking sessions the students together with TNO developed a number of delicious, high quality dishes, in which 3D printing played a key role. The dishes comprised a starter of printed Fabergé goose liver egg, a main course of printed and filled truffle (see image), and an artist dessert featuring a printed portrait of Cas Spijkers.

One of the workshops was given by Michelin-starred chef Wouter van Laarhoven, a visiting lecturer at the Cas Spijkers Academy. He presented the results of a one-week, 3D food-printing project carried out with TNO, and explained the process from 'concept to plate'.

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## MORE FIBER; LESS FAT, SALT AND SUGAR

COLLABORATIVE RESEARCH WITH PARTNERS FROM THE WHOLE CHAIN INVOLVED

In a unique public-private collaboration with a group of food companies, TNO is developing strategies and processes for multiple reformulation of food product recipes. The project focuses on reducing fat, salt and sugar as well as an increase in fiber content and protein substitutions - without compromising sensory properties or shelf life.

In the project, the participating companies, Koninklijke Peijnenburg, Zeelandia, Enkhuizer Koekfabriek, Sensus, Kikkoman, Enkco and Royaan are given access to TNO's leading-edge pre-competitive scientific knowledge. Wageningen UR Food & Biobased Research - another research organization participating in the collaboration - will, via consumer studies, provide insight into consumer demand for and acceptance of the reformulated products. Retailer Albert Heijn will act as external advisor.

The consortium is an important project in the Netherlands which covers the complete food chain and combines experience and expertise from pre-production to consumer behavior. The project will enable the food industry and

retailers to reduce the time-to-market for healthy and sustainable food products. The collaboration, which started a year ago and will continue at least until 2015, reflects the increased focus of the Dutch government on healthy and sustainable food production, as debated in (the second house of) the parliament in April 2013.

Ronald Visschers, Business Line Manager at TNO: “The Dutch Minister of Health, Welfare and Sports states that, in spite of the considerable efforts of the food industry, major improvements are still essential. This project is a valuable contribution to this goal.” Diederick Meyer, Scientific and Regulatory Affairs Manager at Sensus: “The results of this project will improve our knowledge of the

application of our ingredients, enabling us, with our customers, to develop healthy and tasty products with reduced sugar and fat content.” Marloes Kramer, Manager R&D at Koninklijke Peijnenburg: “Working together with TNO allows us to develop healthier products without compromising taste”.

### SUCCESSFUL MULTIPLE REFORMULATION OF FOODS

In establishing the consortium, the participation of ingredient suppliers, food producers and the retailers (wholesale) was a key goal. This broad participation contributes to the development of the integral knowledge required for establishing strategies to replace several ingredients at the same time, from model system to application and implementation. This will be a major breakthrough in multiple reformulation.

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# INSECTS: THE FOOD SECURITY SOLUTION?

TNO is leading innovation into insects as human food in an extensive, collaborative project called *Flying Food*; guiding the development of new approaches to sustainable and market-led cultivation and processing of insects for human consumption and to the marketing of insect-derived foods.

Many people in developing countries - especially the poorest people - are suffering from protein, vitamin and mineral deficiencies. "They might eat maize and rice on a daily basis, but they cannot afford more-nutritious products like meat and dairy", Mathilde Miedema, Program Manager at TNO Innovation for Development, explains. Traditionally, to fill this gap, people in rural areas of these countries catch insects in the wild, such as termites, grasshoppers and crickets. "This is a useful habit, as insects have a high nutritional value, containing high levels of proteins and micro-nutrients", says Miedema.



African consumer insights, generated by the project, will support the introduction of this new and cost-effective protein source into the western diet. "To ensure worldwide food security, we must intensify our use of protein sources that are more sustainable than traditional meat", Miedema stresses.

Two years on, progress is excellent. "We have built a strong consortium which is fully committed to this innovative approach, have succeeded in rearing crickets at an African University and have taught local farmers how to cultivate, rather than just catch, insects. Currently 25 farmers are enthusiastically cultivating crickets", Miedema illustrates. "The next step is to scale-up the rearing and to develop a range of processing methods and recipes for attractive insect-protein foods, such as wheat or maize flour enriched with insect protein, for the making of muffins and samosa's. These products will be produced by newly-established processing companies and marketed in conjunction with a solid communication and advertising campaign", says Miedema. "Our expectations are high."

## EFFICIENT PROTEIN SOURCE

What's more, insects can be reared more efficient than meat. They reproduce quickly, are easy to cultivate and need infinitely less space than cattle. The combination of sustainable rearing, income generation for small farmers and access to nutritious food for families in developing countries is what attracted TNO and its partners to start the *Flying Food* project. The initiative will establish 4,000 inexpensive, manageable and scalable cricket farms and four food-processing plants in Kenya and Uganda, for the year-round cultivation, harvesting and processing of insects for food production. The goal is to create a new value chain, with a sound business model for all stakeholders, bringing a huge local socio-economic impact.

## MUTUAL LEARNING

*Flying Food* is implemented by a coalition of 14 public and private partners in the Netherlands, Kenya and Uganda. "TNO contributes with extensive knowledge about the processing and storage of insects, and business models for innovation", says Miedema. "In exchange, we are learning, from the African culture, how to launch insect-derived products onto the market and how to convince consumers to eat insects."

## ENORMOUS MARKET

Developing countries and emerging economies offer an enormous consumer and producer market to western food industries. "The idea of African and Asian countries as needy and incompetent is past", stresses the program manager. "Investors will contribute to solving the global food security issue and make significant profits."

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# UPCOMING EVENTS:

<b>Okt 28 - Nov 1</b>	<b>Yokohama (JP)</b>
IDF World Dairy Summit	
<b>Nov 6 - 7</b>	<b>Beijing (CN)</b>
China International Food Safety & Quality Conference	
<b>Nov 12 - 15</b>	<b>Bologna (IT)</b>
EFFoST Annual Conference	
<b>Nov 13 - 14</b>	<b>Montpellier (FR)</b>
Food safety: 5th "Rencontres Qualiméditerranée"	
<b>Nov 19 - 21</b>	<b>Frankfurt (G)</b>
Food Ingredients Europe (FIE)	
<b>Feb 25 - 26</b>	<b>Noordwijk (NL)</b>
Annual European Food Manufacturing & Safety Summit	
<b>Feb 26 - 28</b>	<b>Anaheim (USA)</b>
Global Food Safety Conference	

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## TNO HEALTHY LIVING

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

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