TiFN

FOOD & NUTRITION

SUMMER 2019

Erik van der Linden

Entering a fascinating phase

Rob Beudeker

Advancing the frontiers of science

Wouter-Jan Schouten

Establishing a circular food system is a major challenge

COLOPHON
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"Connecting science, society and industry"

"Current global developments offer the agrifood industry plenty of innovation opportunities. The growth in the world population, for example, increases the demand for food products that are nutritious, affordable and attractive to consumers in different countries with different 'national' diets. This requires new approaches to sustainable sourcing and production. People are living longer and age-related health problems are causing health care costs to rise. In my opinion, healthy nutrition could and should play a more prominent role in the prevention of chronic diseases. Unraveling the health effects of nutrition – throughout all life stages – will allow us to develop targeted, perhaps even personalized, products, programmes and interventions.

But, before we can do so, there are many complex issues to be addressed. This requires research that is not only multidisciplinary, and sometimes even transdisciplinary, but is at the cutting edge of different disciplines; an approach for which individual companies usually do not have the knowledge or facilities. In sustainable dairy production, for example, one should not only take steps to minimize the carbon footprint, but also investigate biodiversity and regulatory aspects, and what farmers can and are willing to change in their daily practice.

True innovation

True innovation starts when science, society and industry recognize our common interests and ambitions in food, nutrition, health and sustainability. All parties should identify where they see the major opportunities and, together, become a united force for change. This is precisely what happens in TiFN and what I believe makes our collaboration unique. We are far more than a pile of projects in a glossy folder. We also develop a research strategy that connects the 'golden triangle' of science, society and industry, and provide a valuable learning environment for PhD fellows: the academic and industry leaders of tomorrow. In this way we further strengthen the infrastructure of our country.

Leading position

Globally, the Netherlands are ranked second in the export of agrifood products, and our academia and research institutes are world leading. Several food multinationals have located their headquarters and/or R&D centres in this country. If we want to maintain our competitive position, we should combine our strengths and tackle the world's major issues together.

I expect the coming years will see us take major steps towards sustainable production, together with breakthroughs in how to involve consumers in the transition towards healthier and more-sustainable nutrition patterns. We are on the verge of a radical advance in our knowledge of how nutrition works, and this will provide superb leads for product development. But only if we work together, in a non-competitive environment like TiFN."

Margrethe Jonkman

Global Director Research & Development (CTO) and Member Executive Leadership Team, Royal FrieslandCampina. Chair of the Board at TiFN

“Constantly improving our impact”

Ronald Visschers

Managing Director TiFN

TiFN is the leading, independent platform for collaborative research projects in food and nutrition in the Netherlands. A position that has been built in more than twenty years and that can only be sustained by ongoing reflection on strategy, content and modus operandi, says Managing Director Ronald Visschers: “It is through joint learning with our partners that we constantly improve.”

The driving force behind TiFN is to develop and apply the knowledge needed to provide sustainably produced, healthy and attractive food products. Our partners believe this challenge can only be met when it is fueled by non-competitive, public-private research”, says Visschers. Today’s challenges encompass the natural, economic, social and consumer sciences, which must be addressed as one. “We facilitate close working relationships, in projects that provide insights and deliver the impact industry and society requires. A whole-systems approach, so to say”, he continues.

This systems-approach philosophy has evolved in line with the increasing demand for innovation-driven societal and economic impact. TiFN sensed this impending change and organized its activities into three closely linked impact areas: Consumer Engagement, Healthy Nutrition and Sustainable Food Systems. In our previous magazine released in mid-2017, this approach is broadly described *(https://www.tifn.nl/organisation).*

The first impact area develops strategies for the private and public sectors to empower consumers to make better choices in health and sustainability, and to identify what drives these choices. The second focusses on improving specific health conditions by understanding how individual humans, including their microbial communities, respond to food composition. The third focusses on making production and food processing more sustainable through new regenerative and integrated approaches. Each area addresses specific Innovation Challenges (see figure on page 8).

This magazine highlights the progress made in rolling out our philosophy in projects, and how these are executed and experienced by our partners.

Unique ways of working

“Across the globe, many organizations and institutions find collaborating with competitors in a non-competitive setting a unique opportunity. At TiFN this has been everyday practice since our founding, 22 years ago”, says Visschers. “Partners benefit from our home-grown governance structure, and project management tools that ensure effective working together. Newcomers in our projects are often impressed with our ways of working.” (see figure)

“An example is how we create separate project and expert councils and organize regular meetings for them – often at partner locations”, he continues. “We also invite independent reviewers to comprehensively evaluate project processes and outcomes, mid-term, from scientific, industrial and societal perspectives. Our approach ensures independent, collaborative thinking and manifests in every element of our work.”

Other examples are our Ambition-To-Results (A2R) and Results-To-Success (R2S) workshops: gatherings that help project partners clearly define research targets and maximize synergy when valorizing results. “In the A2R workshops we ensure that research questions are well-articulated and in line with the expectations of the partners involved”, Visschers explains. “In the R2S workshops, held one year before the completion of a project, we evaluate whether every partner’s research targets will be achieved.

We also examine whether it will be possible to improve valorization of generated knowledge during the final year, and what that might require.” The point that Visschers makes is that TiFN guides the project from start to finish, based on previous learning, and continuously strives for more-effective ways of working.

Nourishing human capital

Through two decades of top-class research, TiFN has amassed a deep base of knowledge and understanding that supports our work in important fields such as sensory science, dairy science, oral microbiology and personalized nutrition. TiFN has not only helped to develop expertise and establish extensive networks within and beyond the Netherlands, but also significantly contributed to human-capital development in the Dutch agrifood sector. "While at TiFN, PhD fellows have plenty of opportunities for professional and personal development. Their careers often take them into leading positions in industry or academia where they benefit from the skills they acquired", says Visschers.

The Managing Director is also proud of TiFN's achievements in recent years, from establishing a rejuvenated research portfolio that serves both industry and society to defining and shaping the R2S workshop. "We all believe the key to sustained success is to never stop learning."

Increasing added value

The world of food innovation is changing as we speak. New questions about the relationship between food, health and global sustainability arise every day, and concern around issues such as food security is growing.

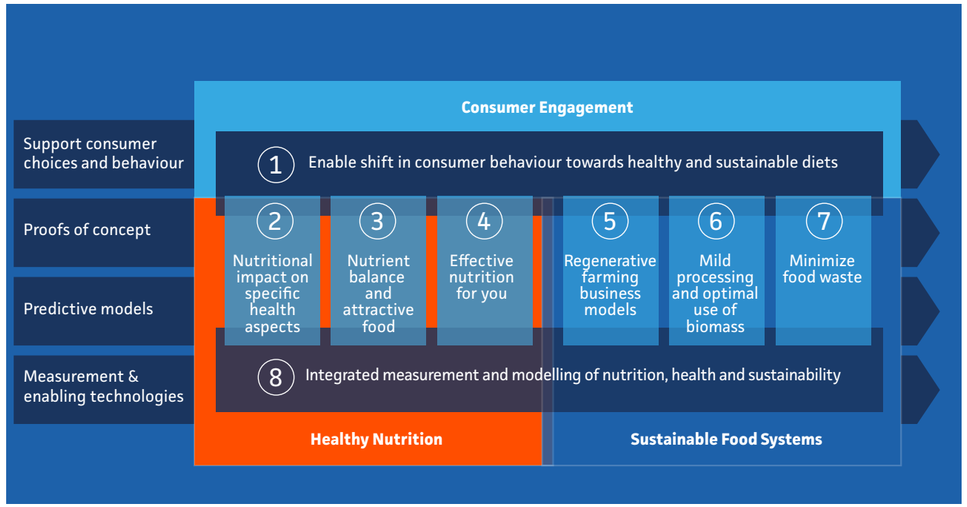
"TiFN's response is not to repeat what are already accepted facts, but to provide practical solutions by doing what we are good at", stresses Visschers. "We saw that industry wanted to better understand what drives consumers, predicted the movement towards personalized nutrition solutions and recognized the potential impact of regenerative food systems. We responded to each of these issues by adapting our processes and portfolio." The need for faster implementation was also identified as crucial to continuing success, and resulted in the A2R and R2S workshops which, for example, improve every aspect of results delivery.

"We endeavour to support project leaders in dealing with the increasing numbers of stakeholders, and we delight in sending well-rounded and impressive PhDs out into new positions in industry and academia and, more recently, as start-up entrepreneurs", says Visschers. "So, we are constantly looking at ways to provide more added value to our partners, be it via new research themes that transcend our current research portfolio, by creating new governance structures that respond to societal questions, or simply by helping team members to learn new skills."

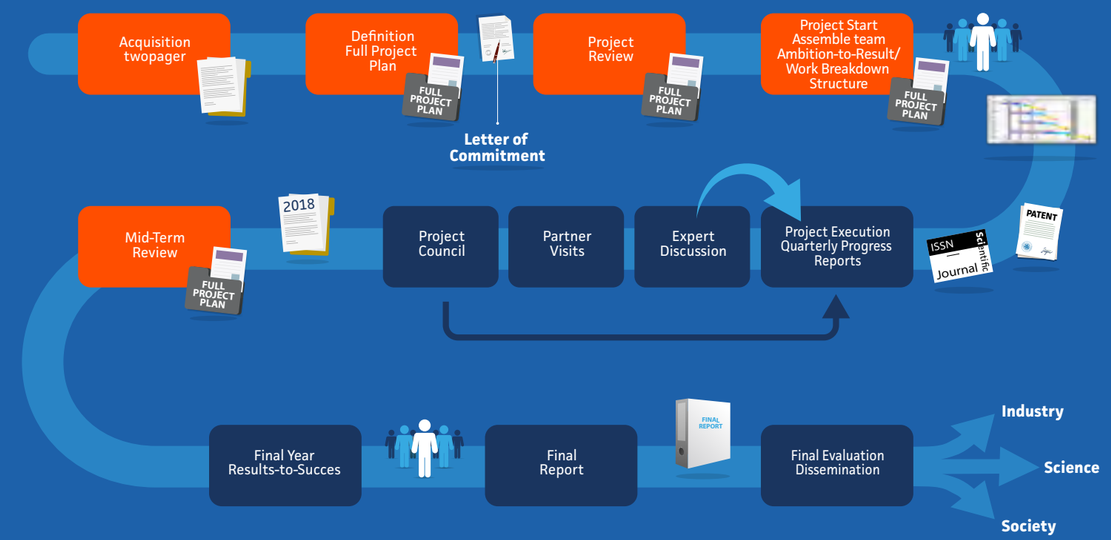
From vision to action

According to Visschers, "TiFN owes its reputation to a sharp focus on collaboration, consistency, cohesion and quality, and by equally valuing every member of the team. It is by putting this vision into action that we have earned such a strong position: one we are determined to keep."

Three themes and eight innovation challenges



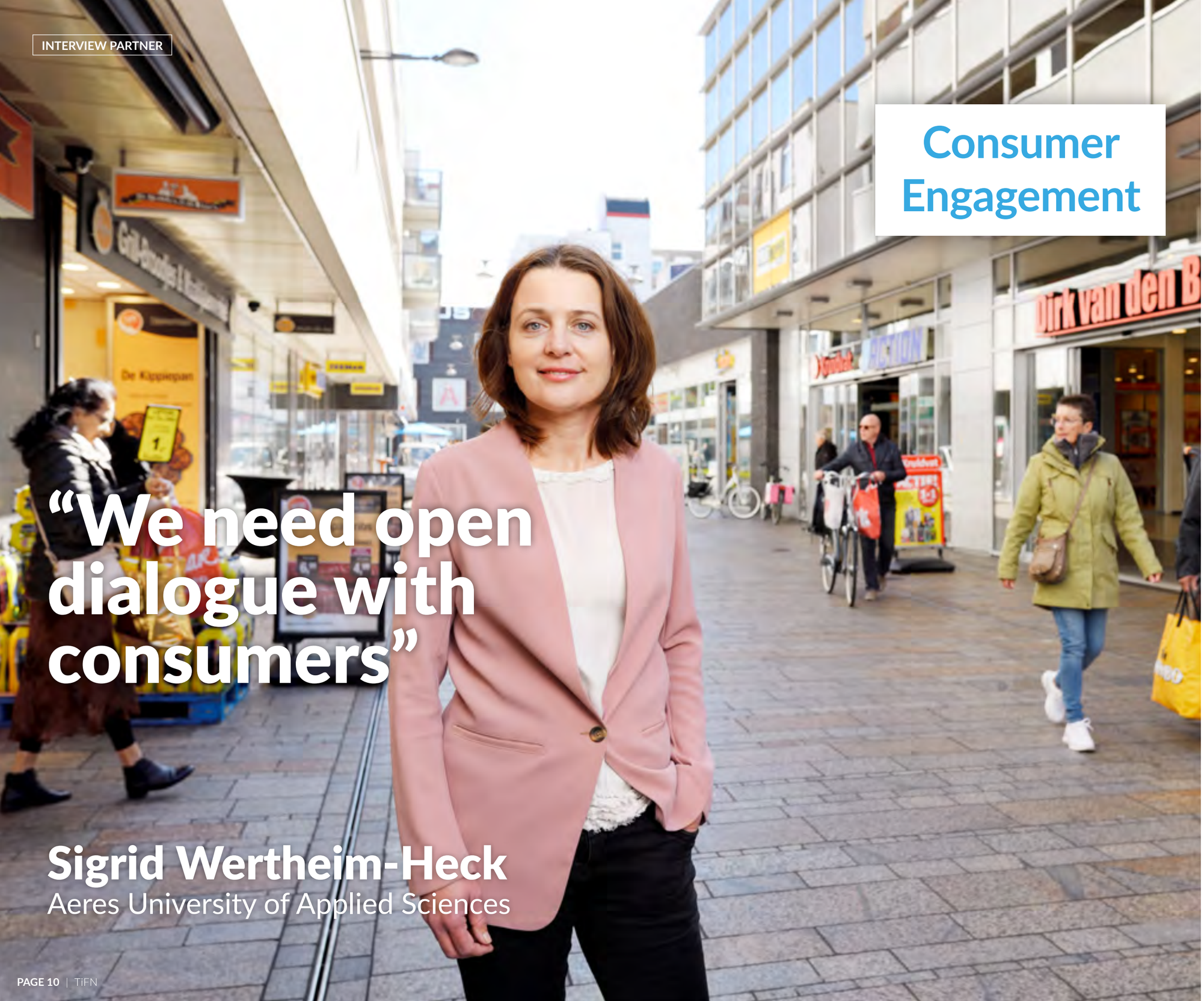
The TiFN Project Cycle: over 20 years of experience



MISSION

TiFN initiates, organizes and performs non-competitive, public-private research in food and nutrition, informed by the demands of business and society and led by results-oriented project management. The overall ambition is to support an agrifood chain providing sustainably-produced, healthy foods that consumers find attractive.

For an overview of all current and recently completed TiFN projects, take a look at www.tifn.nl



Consumer Engagement

"We need open dialogue with consumers"

Sigrid Wertheim-Heck
Aeres University of Applied Sciences

The issue of healthy and sustainable nutrition is high on the agendas of both government and industry. But policies and interventions will only be accepted and effective if there is open dialogue with consumers, stresses Sigrid Wertheim-Heck, Professor Food and Healthy Living at the Aeres University of Applied Sciences in Almere, and senior research fellow at Wageningen University & Research: "We need to restore consumer confidence and make healthy and sustainable food routine."

Reductions in salt and sugar levels, new quality standards for animal welfare and famous actors appearing as health gurus: healthy and sustainable nutrition is clearly hot and happening. Nevertheless, these foods have a limited market share, just 10%. Not enough to enable the transition necessary for both the environment and food security, stated Wertheim-Heck in her 2016 inaugural speech *Dagelijkse kost: het bevorderen van een duurzaam en gezond voedselsysteem voor de stad* (Everyday fare: promoting a sustainable and healthy food system for the city). The professor leads a research agenda for Aeres University of Applied Sciences and is helping structure TiFN's Consumer Engagement research programme.

"Consumer confidence in industry, academia and politics is decreasing", Wertheim-Heck says. Moreover, the growing distance between production and consumption, and the complexity of global food supply systems, has created a kind of food 'alienation'. "Consumers no longer know where their food comes from, how it was produced and exactly what it contains."

Kohlrabi with oysters

Another challenge is the limited social reach of health and sustainability. "It is currently (mainly) presented as a lifestyle only the affluent few can afford." Sigrid says. Initiatives that celebrate the Dutch cuisine with posh recipes that place dressed-up kohlrabi with oysters, have value, but will never interest the masses. "Nine out of ten consumers lose heart when they see a recipe like that." It is also important to make sure that what is offered is attainable, and fits with the lives of everyday people.

Consumer Engagement innovation challenge:

To stimulate a shift in consumption patterns towards a healthy and sustainable diet and restore a relationship of mutual trust.

This research programme is dedicated to the design and validation of interventions that facilitate healthy choices and actively involve consumers. In particular, the programme focusses on the benefits of participatory research methods. Involving subjects in a study could be the key to creating direct impact through research. TiFN's research aims to reveal when these approaches can be most successful.

And then there is habit. "The purchase, preparation and consumption of food is mainly routine, and easily sidetracked by ordinary life events", Wertheim-Heck explains. "You might plan to buy groceries from a local farm, but what if you are working late? You want to prepare fresh meals every day for your family, but there are so many calls on your time."

Common sense

Health and sustainability should become the norm and, for this to happen, we need to engage with every consumer, she stresses.

"We should embrace the cultural diversity that exists in our society, because there are multiple ways in which we can shape the transition. We can start today, paying attention to ordinary daily consumption, while creating space for incremental steps alongside future-oriented, large-scale, possibly radical, solutions. Listening to ordinary consumers, as they go about their daily routines, is crucial to entering into a dialogue with them."

Participatory research

This is precisely the philosophy behind TiFN's ***Consumer Engagement*** research programme. The research aims to explore, develop and improve participatory research methods, in which consumers are empowered by active involvement in project activities and goals. "Think, for example, of brainstorm meetings with parents and schools around healthier lunch snacks for children; dinner events in which consumers and scientists share ideas about sustainable meals; co-designing food outlets and co-developing communication that increases the impact of local policies."

The World Food Center Experience (WFCE) in Ede, opening 2021, will provide the perfect location for this initiative. "The center will offer visitors an interactive food and nutrition adventure that's both fun and educational. A wonderful environment to establish and maintain dialogue for a sustained change to healthier and more sustainable food consumption", Wertheim-Heck concludes.

Sigrid Wertheim-Heck: Professor Food and Healthy Living at the Aeres University of Applied Sciences and senior research fellow at Wageningen University & Research

INTERVIEW PARTNER

Leon Meijer

Municipality of Ede

"Health and sustainability are key to the municipality of Ede's policies. For example, we are working hard to optimize both our youth services and our facilities for independent-living elderly, and to convince our residents that making a healthy choice can also be an easy choice. The World Food Centre Experience (WFCE), which will open its doors in 2021 as part of the new Food Innovation District, will have an important role in our approach.

The WFCE will be a unique agrifood experience center that combines fun with education, comparable to famous museums such as Nemo in Amsterdam and Corpus in Leiden. A place where visitors will experience, for example, the hidden effects of food on the environment, and will be able to taste and smell a variety of food products. Although visiting the centre should be fun and informative, it should also spark people to develop an ongoing awareness of the impact of their food choices. It is hoped that this, and learning about other key health and sustainability issues, will guide them to a new and better understanding of food and nutrition and, eventually, to changes in eating behaviour.

"Reaching a target (group) that everybody is missing"

Filling the knowledge gap
The 330,000 enthusiastic visitors, expected every year, will make the WFCE the perfect location for this much-needed consumer research. Scientists, industry and government have amassed significant knowledge about agriculture and food processing, but we need to know more about consumer motivation and behaviour. Why, for example, do we allow our children to consume so much sugar when we know this causes caries and obesity? Or what should be on sale in a 'healthy' sports canteen? TiFN's interdisciplinary research programmes, focussed on developing methods that will actively involve consumers in product development, education and public campaigns, will go a long way to filling this knowledge gap.

Putting us on the world map
Apart from generating new insights, the WFCE will bring benefits in several other ways. It can, for example, be a platform for the development of tailor-made health education programmes. The center will provide extra employment for the citizens of Ede and will motivate them to make healthier and more-sustainable choices. It is already putting Ede on the world map, and so reinforcing the global perception of the Netherlands as a leader in food and nutrition science. The UN Food and Agricultural Organization (FAO) recently awarded Ede a prize for its integrated health and sustainability policy with these words: 'You are reaching' a target group that is missed by all other policies."

Leon Meijer: City Councillor Ede, the Netherlands

Elly Mertens

Wageningen University & Research

"SHARP dietary patterns differ across Europe"

"I enjoyed my Master's study so much that I wanted to continue research via a PhD fellowship. In collaboration with TiFN, I became involved in an exciting project concerning nutrition, health and sustainability. The aim of my research, which began in September 2015 and will be completed by the end of 2019, is to develop dietary patterns that are SHARP (Sustainable - environmentally friendly, Healthy - in terms of nutrient supply, Affordable - accessible, yet supporting the EU agrifood sector, Reliable - stable in supply, and Preferred by consumers - consistent with cultural norms and food preferences).

Too much meat, too few vegetables

Initial findings confirm our hypothesis that the dietary patterns of most people are far from ideal: too much meat and too few vegetables, fruits and legumes. I am now applying diet-modelling techniques to understand how best to approach improving this situation. The **P** of SHARP implies that proposed dietary changes are based on best dietary practices that currently exist within the population, and so are considered as realistic and relatively easy to implement. The dietary pattern that is the most 'SHARP' will differ per country. It will depend on, for example, current eating habits, the availability and price of food products, whether they are locally-produced or imported, and issues of population demographics. Therefore, I am now also investigating SHARP dietary patterns for Denmark, the Czech Republic, Italy and France. These four countries were chosen to capture the wide range of foods and agricultural commodities that make up current European food consumption patterns.

Well-considered decisions

I really enjoy working at Wageningen University and, especially, in a project sponsored by TiFN: personal and professional development training is provided and the benefits of being in an experienced project team are enormous. Our frequent discussions with academic and industry partners help me to make well-considered decisions on the direction of my work. Should I, for example, dive deeper into certain outcomes of an analysis or, at this moment in the project, look to strengthen my presentation and communication skills. In the beginning I was overwhelmed by the number and rigour of the questions I was asked when presenting my results to the partners. But now I welcome them: they confirm their interest in and commitment to my research."

Elly Mertens: PhD fellow at Wageningen University & Research

Innovation challenge: Integrated Measurement and Modelling

In this innovation challenge existing methodologies and datasets are combined to create a holistic methodology for adequately measuring performance, and to set improvement targets for sustainable production and healthier and more-sustainable diets.

Current project: Scientific knowledge base and data platform for modelling SHARP diets (SHARP-BASIC)

Healthy Nutrition

“Advancing the frontiers of science”

Four research projects up and running and two in preparation: TiFN’s research in the area of Healthy Nutrition is well on track. “We have created a substantial, internationally-competitive research programme that will help us to advance the science relevant to industry and society”, says Theme Director Rob Beudeker.

Empowering the food industry to provide healthy nutrition, personalized across individual life spans, is the ambition of TiFN’s research within the Healthy Nutrition theme. Centered around three innovation challenges – *Nutritional impact on specific health aspects, Nutrient balance and attractive foods* and *Effective nutrition for you* (see text box) – it addresses four major issues: protein transition, personalized nutrition, the microbiome, and facilitating healthy and sustainable food choices.

One current project is *Anabolic properties of plant-based proteins* (2016–2019; three industry and one academic partner), which compares the effects of plant-based protein and animal protein on muscle synthesis. “Increasingly, manufacturers are considering replacing some of the animal protein in their products with plant-based proteins, but do not want to compromise on health benefits”, explains Beudeker. Plant proteins may have a lower bioavailability compared to animal protein as a consequence of plant molecular structures, and amino acid composition may also differ. “We want to understand what this means for the human body.” Initial outcomes are expected towards end 2019.

Investigating our cellular ‘energy factories’

Another example is *Mitochondrial health* (2016–2020; two industry and three academic partners), focussed on assessing the function of mitochondria, the tiny energy factories present in all cells. Scientists believe mitochondria might affect certain ageing processes, including muscle health. In the past two years, a TiFN project team has been developing advanced, non-invasive measurement techniques. “We are now close to measuring mitochondrial activity and energy production capacity”, Beudeker illustrates. The next step will be to apply these techniques outside the lab, in an elderly population, and to assess the impact of interventions on muscle health. Mitochondrial health had its mid-term review in March 2019, by independent scientific reviewers, which resulted in a clear understanding of the way forward.

Beudeker also contributes to a programme that investigates interventions to reduce cognitive decline. “We would like partners from different top sectors to be involved: Agri&Food, LifeSciences and Health, and the Creative Industry”, he says. “This will further broaden our scope and enable us, for example, to develop innovative gaming-based methods for measuring cognitive function, or to communicate lifestyle recommendations in novel ways.”

A third large project is *Unravelling the biology behind perceivable consumer benefits* (2017–2022; three industry and three academic partners), focussed on personalized nutrition. “In academia and industry awareness is growing that what is healthy for one individual is not necessarily healthy for another”, says Beudeker. “Non-invasive techniques to measure ‘personalization’ biomarkers are being developed. This TiFN project concentrates on the links between glucose metabolism, cognition and emotions. We believe consumers will value the benefits targeted dietary decisions can bring in these areas.”

Rob Beudeker

Theme Director TiFN

Beudeker is pleased with TiFN's achievements in Healthy Nutrition. "We have built on and extended an internationally competitive research programme, with committed partners. We are advancing science in ways that are relevant to industry and society."

Frontiers of science

The Theme Director expects that within four to five years the frontiers of science will have advanced significantly. "We will know much more about the microbiome's role in health throughout the lifespan and better understand both individual responses to specific nutrition, and the health effects of plant-based proteins", he illustrates. Technology developments will facilitate the learning. "Large, nutrition datasets are increasingly available that can be translated into personalized advice, and artificial intelligence tools are rapidly arriving that support decision-making."

Healthy Nutrition innovation challenges:

Nutritional impact on specific health aspects aims for greater understanding of the link, at all ages, between the composition and metabolic activity of the microbiota, and of biomarkers for various health conditions.

Current projects:
- Mitochondrial health
- Protein and physical activity to improve muscle health in men diagnosed with metastasized prostate cancer

Nutrient balance and attractive foods is developing a methodology to make healthy choices easier and improve consumer appreciation. It is based on the Nutrient Balance concept, a new metric that reflects the overall nutritional quality of foodstuffs, diets and meal plans.

Current projects:
- Anabolic properties of plant-based proteins
- Smooth bite for all
- Sweet tooth: nature or nurture?

Effective nutrition for you is developing effective, personalized, nutrition and lifestyle coaching. It will increase our understanding of individual responses to changes in diet and lifestyle, and provide insight into what motivates consumers to make and sustain healthy changes. An important target is glucose metabolism. The programme is also developing new research methodologies as an alternative to conventional, randomized, controlled trials.

Current project:
- Unravelling the biology behind perceivable consumer benefits.

“TiFN inspires a wider research field”

“Specializing in medical and early-life nutrition means that fundamental insight into the health benefits of nutrition is just as essential to us as sustainable sourcing and mild processing. However, such research is too complex to conduct in-house only. We joined TiFN in 2010 to combine our strengths with those other leading companies and research institutes in the Netherlands.

Our projects have ranged from muscle health and gut nutrient sensing to sensory liking and food safety. Currently, we are a partner in the projects *Perceivable benefits*, *Mitochondrial health* and *Sustainable ingredients*.

Thanks to research with TiFN, we now have proof-of-principle for nutrients crucial to our strategy and valuable leads that enrich our own R&D. This includes gaining insight into specific protein sources to improve muscle mass in the elderly and patients, the timing of protein supplementation, and technologies to efficiently assess the effects of nutrients on gut health. Moreover, the scientific publications from this research have a positive influence on research in this field: ‘non TiFN’ scientists are diving deeper into, for example, the impact of protein supplementation on the elderly.

Strengthening our network
Partnering in TiFN has proven to be an excellent way to strengthen our network in the Netherlands. During the projects, we learn about the strengths and expertise of the research partners and we regularly continue cooperation with these partners in a bilateral setting. In addition, we have hired several talented scientists whom we first met as TiFN PhDs.

We are very pleased with the TiFN collaboration: we know exactly where we stand and what to expect from each other. Good project management is essential to the success of the research projects: we share our ambitions and expectations as soon as possible and review them as the project progresses. TiFN provides a unique infrastructure and ways of working, for example the Ambition-to-Results and Results-to-Success workshops and regular expert meetings. Moreover, its project leaders are experienced in managing communication between collaborators.

I am looking forward to seeing the first concrete outcomes of our current TiFN projects. I am sure it will not be too long before we can tailor our products even more to the nutritional needs of infants, patients and the elderly.”

Ardy van Helvoort: Director Research at Danone Nutricia Research and associate professor at Maastricht University

Ardy van Helvoort

Danone/Nutricia Research

INTERVIEW ALUMNUS

"My PhD research investigated and confirmed the positive effect of protein supplements and strength-training on muscle mass and physical performance in frail older adults; a growing field in research and health care. I am proud that my work has resulted in so many new insights for future research interventions and practical applications.

I believe our project's enormous impact is down to the combination of talented scientists from academia and industry working together: research questions were investigated from, naturally, the academic perspective, but also with an eye for possible industrial application. For industry, involvement in the project gave them the data and experiences needed to build solid, specific, business cases.

My time at TiFN, from 2008 to 2015, really expanded my knowledge of nutrition and exercise science. I learned to perform high quality research, and to translate science into applicable food products and healthcare interventions. I also developed a deep understanding of the needs of industrial partners. Furthermore, TiFN allowed me to develop personally and professionally: there was budget for personal development skills, conference visits, network building and collaboration with leading (international) experts.

Always valuable

The value of my TiFN learning is confirmed again and again. As a post-doc at Wageningen University & Research, I developed my curriculum vitae, published a range of high-impact publications and gave many lectures. Today, as a researcher at the Amsterdam University of Applied Sciences, I continue in a similar vein. My aim is to put our findings into practice by collaborating with dieticians and physiotherapists in their work environments. With them I discuss issues such as *How can hospitalized older adults achieve their recommended protein levels?* And *How can we best support the frail elderly to perform regular resistance exercise?* And an unexpected bonus: as a TiFN PhD I began to build a network which now stretches across the world."

Michael Tieland: Nutrition, Exercise and Ageing researcher at the Amsterdam University of Applied Sciences, and former PhD fellow

"Top quality research ensures early application"

Michael Tieland

Amsterdam University of Applied Sciences

INTERVIEW ALUMNA

"Nutrition and the immune system: a lifelong interest"

Sandra ten Bruggencate

PanTheryx

"During an MSc thesis in Canada, on malnutrition and the immune system, I was invited to apply for a PhD position at TiFN (then known as Wageningen Centre for Food Sciences). The research would focus on nutrition and resistance to gut infection, already an interest of mine.

From 2000 to 2004, I investigated the effects of prebiotics on intestinal health, a fairly new topic at that time. We challenged prebiotic-fed animals by infecting them with Salmonella and investigated the subsequent effects on gut microbiota, fermentation metabolites, the intestinal wall and pathogen survival. Contrary to our expectations, Salmonella infection was worse on a diet rich in prebiotics. Most likely, rapid fermentation of prebiotics caused the production of organic acids that damage the intestinal wall.

(Pre-) clinical settings

During my PhD period, and later as a project manager at NIZO food research, I substantially improved my understanding of nutrition, intestinal physiology and the immune system, and learned to work in both clinical and pre-clinical settings. My TiFN experience supports me in my current role as a research director at PanTheryx (USA): a medical nutrition company, which focusses on the research, development and commercialization of products to improve resistance against gut infection and inflammation.

Exchanging knowledge and ideas

TiFN taught me that, especially in a multidisciplinary field, the best results are obtained by exchanging knowledge and ideas with experts from different backgrounds. We met regularly with several PhD fellows, project leaders and industrial partners. Today, those experts form my professional network, essential to progressing in many pre-clinical and clinical project activities."

Sandra ten Bruggencate: Research Director at PanTheryx and former PhD fellow

Yfke de Vries

Avebe

"Challenged to be firm and clear"

"After obtaining my Master's degree in Sensory Sciences at Wageningen University, I was looking for an opportunity to immerse myself in this exciting field. When I saw TiFN's vacancy for a PhD fellow, to investigate changes in taste and flavour perception during chemotherapy in cancer patients, I did not hesitate to apply. My PhD began in February 2013, shortly after my graduation.

My project showed me that patients' capability to perceive and differentiate odours remains normal, but taste perception changes. This manifests as reduced liking and consumption of certain foods, with breast cancer patients tending towards less fat and protein. However, medical nutrition often contains high levels of protein as it improves post-treatment recovery.

Pushing research to the next level

Participation in expert meetings with TiFN industry partners has been so instructive and educational for me: their questions and suggestions always pushed my research to a higher level. Interacting with PhD colleagues, in the project team, was also really valuable.

Additionally, I learned how important it is to communicate clearly, the what, how and why behind one's research choices. The supervisors and other PhD fellows in the team brought different backgrounds, opinions and ideas. I was challenged to find robust arguments to support any new directions I proposed for my research. I also learned to draw firm conclusions, rather than, as scientists can easily do, get lost in the details.

Other side of the table

In my current job, at Avebe, these 'new' skills are proving their value on a daily basis. I translate flavour perception of our products into manufacturing processes, but also look forward to define value propositions for our products. Therefore, I work cross-functionally with process engineers, innovation scientists and colleagues from sales and marketing. In order to keep moving forward, clear and straightforward communication on the what, why and how of sensory research is essential.

I am pleased that, just as during my TiFN adventure, I am still doing sensory research, though now I sit at the industry side rather than the university side. It really helps that I had already become familiar, during my PhD project, with the goals typical of industry partners when they collaborate with research institutes."

Yfke de Vries: Taste and Nutrition Specialist at Avebe and former PhD fellow

“Integrated approach needed to establish a circular food system”

“Establishing a circular food system is a major challenge for every player in the system. Large-scale transition is only possible with an integrated approach in which circular business models become competitive with mainstream linear business models”, says Theme Director Wouter-Jan Schouten.

“Actually, natural food systems are fully circular at the ecosystem scale. From the moment that humans invented agriculture, circularity decreased. Over the past century the system became much more productive but also more linear. Improved efficiency went hand in hand with an increasingly negative impact on biodiversity, soil, water, nutrient cycles and climate. This development must be reversed by returning to a circular system, in which food production has a positive impact, while continuing to produce sufficient food. Regenerative farming business models, mild processing and optimal use of biomass are key to transitioning to such a system.

The topic is high on political and industrial agendas, confirmed by the new vision of the Dutch minister of Agriculture, Nature and Food Quality. The programme Nederland Circulair (Circular Netherlands) has delivered a transition and implementation agenda for Biomass and Food. Several grassroots initiatives have been launched, such as the Deltaplan Biodiversiteitsherstel (Delta Plan Biodiversity Recovery), the Transition Coalition Food, and the Innovatielab Voor de oogst van morgen (Innovation lab for the harvest of tomorrow). Moreover, agricultural entrepreneurs are pioneering novel approaches to circular business models.

New paradigm

At TiFN we are enabling and accelerating the transition from a linear to a circular food system, while ensuring our solutions offer business opportunities to our chain partners. In the *Regenerative farming* project, for example, we are developing a scientific outline of a regenerative farming system at scale, hand in hand with building a community of practice in which groups of farmers are already implementing radically new approaches. We gathered a broad group of scientists from different fields such as biophysics and socio-economics and from leading research organizations like Wageningen University & Research and the Copernicus Institute of Sustainable Development (Utrecht University), to investigate these issues from their individual perspectives.

Broadening the scope

Our challenge for the coming years is to accelerate the adoption of regenerative farming methods, which will require a strong and resilient business case for these methods. Extensive cooperation between government and chain partners, and support from both, will be necessary, as farmers will have no choice but to change the structure and processes of their businesses. We are, therefore, bringing more companies and knowledge institutes on board. These new project partners will support the development of a diversity of regenerative farming methods, and dive deeply into specific opportunities such as applying robotics and artificial intelligence in support of regenerative farming.

I hope that, within four years, government and chain partners in the Netherlands will see concrete opportunities for moving towards a circular food system, driving the transition and making the Netherlands a world leader in this field.”

Wouter-Jan Schouten
Theme Director TiFN

Sustainable Food Systems

innovation challenges

Regenerative farming business models aims to develop proof-of-concepts for how regenerative production can be achieved within one generation, from both bio-physical and socio-economic perspectives.

Current project:
- Regenerative farming

Mild processing and optimal use of biomass is identifying long-term potential of, and requirements for, optimal valorization of existing biomass through enzyme technology, fermentation and other mild-processing approaches.

Current projects:
- Evolutionary trade-offs in dairy fermentations
- Heterogeneity in spores of food-spoilage fungi
- Sustainable ingredients

Minimum food waste aims to identify the long-term potential of waste-prevention solutions, and to develop proof-of-concepts and business models for the most promising solutions.

Erik van der Linden

Theme Director TiFN

"We are now entering a new and fascinating phase"

Will understanding how systems manifest at different scales be the key to solving the highly-complex problems we expect in the future of nutrition, health and sustainability? Theme Director Erik van der Linden shares his vision.

"For over twenty years, TiFN has investigated how the molecular manifests in the macroscopic: how the smallest molecules and ingredients influence end-product performance. We learned that properties at the molecular scale often translate from microscopic to macroscopic scales in a regular and smooth manner, allowing for quantitative predictive modelling of actual product properties, such as taste, crispiness and mouth feel. We are now entering a new and fascinating phase.

Mild processing

The current *Sustainable ingredients* project is investigating this smoothness along scales in systems with more, and different, ingredients. In such complex systems, interactions between the different components play a role, often in a non-linear manner. However, and importantly, smoothness across scales is often still present, again facilitating predictive modelling and targeted interventions. Imagine, for example, the use of mildly-processed rapeseed: if you crush and soak it, you will get a mixture of fibres, soluble carbohydrates and protein aggregates. Our aim is to model the properties of such products, and all their ingredients, across relevant scales, in ways that support the industry to develop food products directly from these raw material ingredients, so avoiding energy-consuming separation techniques.

Another current project, *Smooth bite for all*, investigates an even more complex system: the interplay between macroscopic properties, chewing behaviour and perception during consumption, again across scales.

Bridging material and life sciences

This regularity across scales often results from the mobility of elements present in systems and the tendency of systems to optimize their energy management. Within TiFN we will, in the coming years, increase our focus on systems of which parts are constantly receiving energy: this will connect the material sciences with life sciences from micro to macro scales. This approach applies, for example, to the formation of biofilms by bacteria under flow, and material fermentation for sustainable food ingredient supply.

Sustainable food systems

Just as fascinating and challenging is how to move beyond the material and life sciences and embrace the social sciences, while acknowledging, and perhaps maintaining, smoothness and regularity across scales. This perception of a 'systems approach' – first outlined in a paper published in the peer-reviewed journal Trends in Food Science and Technology (2014) – will allow us, in the future, to solve even more complex issues of nutrition, health and sustainability."

"Regenerative farming is gaining traction"

Hannah van Zanten

Wageningen University & Research

"Together with colleagues from Animal Production Systems at Wageningen University & Research, we have been trying to put Regenerative Farming on the scientific and political agenda. In recent years the focus was mostly on minimizing environmental impact, while maintaining or even increasing production volumes. But we strongly believe that a radically different approach is needed: an approach that allows us to produce our food with respect for the physical limitations of our planet.

My research focusses on the role of farm animals within such a regenerative farming system and their contribution to the food system. Wouter-Jan Schouten brought us together, with other research groups in this field who offer different expertise, in TiFN's *Regenerative farming* project.

In October 2018 we kicked-off with an Ambition-to-Result (A2R) workshop. Everyone was present, from two PhD fellows and their supervisors to the various industry and research partners. Based on the outcomes, the PhD fellows compiled their sub-project proposals and are now working on their first review articles.

Full focus
I find it inspiring to work with so many, committed, partners from different fields, and I believe structured regular exchange is essential even though we might sometimes feel too busy. TiFN is facilitating the communication process very well: during the A2R workshop, for example, we gathered for two days off-site, in a hotel, to make sure we were not distracted by other work-related issues. The meeting was led by professional dialogue facilitators, who summarized and documented actions and agreements, and gave all participants time to share their thoughts and concerns with the group.

Making good decisions
Currently, carbon footprints are mainly used to assess the environmental sustainability of products. An approach that identifies the individual footprint of products, however, does not address the complexity and circularity of a food system. Increasing the amount of concentrates instead of roughage in cattle feed, for example, would reduce the environmental footprint of beef. At the same time it would ensure an increase in feed-food competition, increasing the use of arable land in the entire food system.

The research will include using a food-systems approach to model bio-physical aspects, thereby acknowledging the interdependence of the food system. We will begin by upscaling the potential of existing approaches to determine their benefits. In this way we will help farmers to make the best possible decisions when creating sustainable business models."

Hannah van Zanten: Assistant Professor Animal Sciences Group, Wageningen University & Research and PhD supervisor in the Regenerative farming project

PARTNER INTERVIEW

"Regenerative farming: utility, necessity and added value"

Reggy van der Wielen

FrieslandCampina

"At FrieslandCampina we believe we can and should play a leading role in reducing greenhouse gases and increasing biodiversity. We are a company owned by a cooperative of 18,000 dairy farmers. Our business covers the whole dairy production chain, from grass to glass.

TiFN's *Regenerative farming* project, which began mid 2018, supports us in our desire to meet the targets of the 2015 Paris Climate Agreement. FrieslandCampina aims to be a leader in sustainability and encourages its member farmers, through financial incentives, to make their businesses more sustainable. What makes this project unique is that it does not consider only technological opportunities, but also the socio-economic feasibility of more-sustainable farming approaches. Groups of farmers will be actively involved in the project to experiment, test and learn in a co-creative environment. All these aspects are crucial for success because, in the end, changes must take place on the farm; changes that will still guarantee farmers a good living.

I hope that, when completed in 2022, the project will have delivered a range of usable insights and transition scenarios that will help our farmers towards a sustainable future. We believe it is important that farmers have the freedom to choose those models that best fit their businesses.

Passionate, open minded and curious
I am very enthusiastic about the collaboration so far. We are working with an experienced and committed project team, with many different disciplines and backgrounds, from social scientists to farmers and mathematicians. Partners are passionate, open-minded and curious, welcoming the opinions and interests of others, and everyone involved is driven to make this project a success.

We consider the Regenerative farming project as a starting point, leading to add-on projects that will bring us closer to our target. In the project council we are already discussing which stakeholders to approach for the next stage."

Reggy van der Wielen: Director Research & Technology at FrieslandCampina and Chair of the Regenerative farming project council

INTERVIEW ALUMNUS

"A perfect springboard for a succesful career"

André Pots

Unilever Foods Research

"Twenty years ago I became the first PhD fellow to join TiFN; at that time known as Wageningen Centre for Food Sciences. Consequently, I was the first PhD student to graduate as a WCFS/TiFN PhD.

I investigated the physicochemical properties and thermal aggregation of patatin, the major potato-tuber protein. Together with another PhD fellow we determined the conformational changes of the potato protein, the ingredients responsible for aggregation and how to prevent it. This opened the way to isolating potato proteins on an industrial scale. I'm pleased to see that, over the past 20 years, potato protein has developed from a low-value feed staple to an ingredient used in a variety of food and non-food applications.

Thinking and acting independently

In my first job at Unilever, the personal skills I developed during my PhD were more important than my experience. I have, for example, learned to rely on my own ideas and decisions because, in a PhD project, if you don't do something nobody else will. Now, more than 20 years later, as R&D Director at Unilever Foods Research, I often fall back on the scientific insights and approaches I learned at that time. Potato proteins have become an important player in the transition towards more-sustainable food production, a development in which Unilever is already playing a leading role.

Beyond your specialism

I believe a PhD position at TiFN provides the perfect springboard for a successful career. Learning to think independently, and reflect on your research approaches, results and personal skills, is of great value no matter whether you continue in research or choose a different field. It offers you the unique possibility to learn about much more than just your specialism. You improve your research techniques, but also learn how to work with industry while sharpening your personal skills, and you greatly extend your network. And alongside all the learning and hard work, it really is a lot of fun."

André Pots: Director Unilever Foods Research and former PhD fellow

INTERVIEW ALUMNUS

“Being part of a top team”

“Being a molecular scientist, biotechnology has always fascinated me. After my graduation, and some initial work experience, I realized that if I wanted to be a voice in this field, I had to earn the right via a PhD. Wageningen Centre for Food Sciences – TiFN’s former name – had just been established, and a top institute combining industrially and socially relevant research really appealed to me.

My PhD research focussed on folic acid production (Vitamin B11) by lactic acid bacteria, that are typically present in yoghurt and other fermented food. We applied classical methods and also genetic engineering to increase production of folic acid during a fermentation process. You could say we used the bacterium as a sustainable micro vitamin-factory. The outcome of the research provided guidance to manufacturers on how to industrialize naturally-enriched fermented food.

Optimizing metabolic routes

By optimizing various metabolic routes, we were able to increase bacterial folic acid production 100-fold. Elements from the filed patents for this type of strain optimization are now used by the food industry, though more for natural selection and screening of bacteria rather than for genetic engineering. It is also good to see that my work has provided leads for follow-up research, even further improving production yields.

With professor Willem de Vos as promotor and Michiel Kleerebezem and Jeroen Hugenholtz as my supervisors and co-promotors, I knew I was in an absolutely top team. This team made rapid progress and motivated and stimulated me to give my best. Another great benefit was that TiFN’s network was already pan-European: for example, we worked together with University College Cork on developing a multivitamin B-producing strain.

Interface between disciplines

After completing my PhD project, I joined Nestlé in 2003, moving through a variety of roles in operations and research. Since 2018 I have been Innovation Manager Gut Health at DSM. In my own time I am investigating bacteriophages as an alternative to antibiotic treatment; in 2009 I established, together with a friend, Yoba for Life: a foundation in Africa for the local production of probiotics.

My time with WCFS/TiFN was a source of inspiration for all of this. I not only gained a deep understanding of fermentation and how bacteria collaborate synergistically, I also learned how to present ideas and results, and to initiate research dialogues with scientists in other fields. These skills are essential, as the interface between different disciplines is where real innovation occurs.“

Wilbert Sybesma: Innovation Manager Gut Health at DSM Nutritional Products, Basel, Switzerland, Founder Yoba for Life Foundation and Senior Scientist Balgrist University Hospital Zürich and Lecturer Food Biotechnology Ecole Polytechnique Fédéral de Lausanne and former PhD fellow

Wilbert Sybesma
DSM Nutritional Products

Cécile Renault

The BEL Group

"Sharing learning outcomes with our competitors"

"The BEL Group joined TiFN in 2011. As we have production facilities and R&D in the Netherlands for our Leerdammer brand we already knew TiFN. Crucially, we have a shared vision on healthier and sustainable food: we believe it is important to provide alternative solutions to meet diversity in consumer expectations, such as via plant-based proteins. Working in a non-competitive setting was entirely new for us. We immediately saw the value in the exchanges around fields of interest, knowledge and ideas, and in developing interesting projects together.

Unique integrated approach

BEL is already engaged in sustainable sourcing with its Corporate Social Responsibility programme *We care in every portion*. With TiFN's *Sustainable ingredients* project (2018–2022), we are taking another step forward. The project has a unique integrated approach and investigates every aspect of animal/plant protein replacement. From nutritional value to functional quality and processing, with a focus on pea and linseed as the sustainable protein sources. We expect the project outcomes will help us to evaluate whether these sources are feasible, how much we need to invest in adapting production processes, and how to optimize protein texture for application in products.

Trust and openness

Sustainable ingredients is our third collaborative project, following Food structuring (2011–2015) and *Smooth bite for all* (2015–2019). We remain impressed by the trust and openness between the partners, and I believe the TiFN project leaders directly contribute to this. They have a helicopter view of the sub-studies done by PhD fellows, create a positive atmosphere, and facilitate open-minded, high-level discussions. Each partner has the opportunity to share their opinions, thoughts and ideas.

Investing time

Being involved in a collaboration such as TiFN only works when you are committed, from the beginning, to invest time in valorizing and implementing insights. We placed two BEL experts in the projects just to gather insights and ideas for our in-house R&D activities. They also discuss, with the project team and other partners, how knowledge valorization might be better facilitated. For example, by defining research guidelines tailored to a partner's lab situation, or by attracting ingredient suppliers to the project.

This collaboration feels very rewarding and elicits an abundance of positive energy. I am sure more projects will follow, perhaps with BEL researchers working even closer with Wageningen University."

Cécile Renault: Research Director The BEL Group

"Open, regular dialogue underpins success"

Han Wösten

Utrecht University

"Fungi's heat-resistance makes them tough to control, and so can add difficulty to food processing and storage. Surprisingly though, in contrast to food-spoilage bacteria, they are relatively unexplored. TiFN's *Spores* project (2016–2020) aims to generate fundamental insights into heterogeneity in heat resistance between and within fungal strains. Our key focus is determining the heterogeneity of fungal spores and their environment's effect on their heat resistance.

Substantial heterogeneity
Over the past three years we have developed a range of advanced methods to measure heterogeneity amongst spores. We also demonstrated surprising and substantial heterogeneity in heat resistance between and within fungus strains. Processing environment and spore age do have a major influence. For industry partners the challenge now is to align their quality protocols with the most heat-resistant strains. In parallel, we will, in the final year of the project, conduct further modelling and mechanistic studies, aiming to facilitate quality prediction in common industrial processes, and further extend our fundamental knowledge base.

Successful consortium
In the past years we have had many meetings with our project partners. I believe this frequent dialogue really helps the project run smoothly. Actually this is the most successful consortium that I have ever been involved with: results are delivered on time, team members are complementary in skills and get along well with each other, and industry partners are active and engaged. TiFN is facilitating the process well, via the Ambition-to-Result workshops, for example, but also by keeping our partners closely involved from beginning to end.

Expectations are that the project will enhance targeted control of fungal spores and deliver high-impact publications and leads for follow-up research. I am excited and grateful to be a part of this team and process."

Han Wösten: Professor of Microbiology at Utrecht University and leader of the Spores project

OUR PARTNERS

At the moment of writing, we work together with the partners mentioned below. Of course we are open for new partnerships.

Industry/private partners

Research/knowledge partners

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