

Ingredients

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Freedom of choice is something that consumers have always valued. Today, it is not just an expectation it is a demand. To stay competitive, food producers responded initially by making their products and packaging more attractive. They strengthened brands and developed new marketing concepts. But over the years the focus has, slowly but surely, been drawn towards the intrinsic value of the product itself. Enhancing food products by giving them better taste, texture or health benefit proved to be a good method of attracting consumers.

Ingredients have played a crucial role in this process. By adding, adjusting or replacing them, one can make significant changes in a product. However, this is not an easy task. The ingredient industry may very well know their products, but this knowledge needs strengthening when it comes to the behaviour of their products in other foods and combinations of foods. Adding a specific flavour to pastry or confectionery or dairy products may lead to very different results. That's where NIZO food research can help.

NIZO food research has a long track record when it comes to ingredients. We always work methodically, according to scientific principles, analysing the system in which the product is going to be used. Our business is to predict how it is going to behave, determine that it does what is claimed, determine the safety parameters, and improve its processing. Over the years, customers from all over the world have relied on NIZO food research for support regarding ingredients, knowing that our knowledge covers a vast stretch of the production chain.

That is how a new product develops a sustainable competitive advantage. Not just on the outside, but also in taste, functionality and texture. So that consumers, after sampling it, will decide to buy it again, time after time.

Dr. Ad Juriense,
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Many new food products that we find in the supermarket today, originally were developed by ingredient manufacturers. It shows the increasingly important role of this industry. Today's leading ingredient companies spend between 2% and 5% of turnover on innovation, which is why partnering today's producers and manufacturers requires a range of skills. Dr. Gerhard de Ruiter, manager for the ingredient market at NIZO food research, outlines how the company is helping its customers to innovate.

Innovation in Texture, Taste and Health

There are three main areas in which food and beverage companies are innovating: taste, texture and health," says Gerhard de Ruiter. It is no coincidence that these are the three key areas of considerable expertise at NIZO, where upwards of 100 lab staff are engaged in work on innovation in these key areas. But De Ruiter is quick to point out that it is not just in the labs where work on innovation occurs. "Of course, the results of our work need scaling up to match volume production methods. For this reason, we are also heavily involved in the technology for the processes inside production plants, which is why we have a food-grade pilot plant that complies with the regulations of most countries. Safety (micro-biological), quality and process-optimization are the keywords here."

As an industry leader in R&D, NIZO ensures that it has the right resources to meet customer requirements. That means having the right blend of staff with the right credentials. "About half of our people are recruited from industry and about half from academia," says



De Ruiter, who himself has extensive experience and a strong track record in the ingredient industry. "We all speak the customer's language and help them to earn money by providing the fundamental knowledge and translating it into innovative healthy products having a texture and taste appreciated by consumers."

"Whether involved in consultancy or project management work, NIZO automatically thinks in terms of added (commercial) value for a given investment," reassures De Ruiter. With an unique understanding of the areas of taste, texture, and health, and being able to couple the perceptions of real customers to the physics of food, NIZO is a true partner in innovation.

NIZO offers a broad choice of techniques and concepts. This ranges from the SOIR-concept in the flavour area (see interview with Boelrijk), the PRIME-approach in the texture area (see article on PRIME), and the animal models to

prove health promoting activities of compounds, right up to RNA-based identification of micro-organisms, and to complex analysis of biomolecules. By having its roots in the dairy industry, which has been trend setting for several years, NIZO is in an excellent position to apply its expertise in other industries. One example is the use of predictive computer models, which is already being picked up by several industries. "Predictive modelling shortens time-to-market and saves money," says De Ruiter. "And we pride ourselves on playing a leading role in the predictive knowledge area." Another example is the trend in the marketplace for increased use of non-gmo and natural ingredients. Expertise with these kinds of ingredients (like milk components) makes NIZO now a logical partner also in this area.

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Isn't it the dream of every ingredient manufacturer: find valuable components in your raw material or in a "waste" stream, and isolate them through a cost-efficient process? This dream can come true. Of course not by hoping or dreaming, but by a systematic and thorough approach.

FOOD VALORISATION

Getting the best out of your ingredients

The dairy industry has been doing this for years. Both milk and whey are 'torn to pieces' to extract value-added components. Elsewhere in this edition you can read the story of DMV, as a prime example of a company involved in milk valorisation, producing both lactose and lactoferrin. Especially in the latter case, not only finding and isolating such components, but also showing the nutritional benefits are essential to the success of DMV. Such challenges are daily practice for our experts in food

valorisation and nutritional health claims. They love questions like: How to isolate a component without destroying its active configuration? Can we develop a process to recover a component, present at ppm levels? To which degree does my ingredient need to be purified to do nutritional studies?

EXTRACTING SAFE INGREDIENTS

The key issue is to find out whether the component has a significant health-promoting effect. This starts with in-vitro

models, followed by animal infection models and is concluded with human studies. For the latter, amounts in the order of a kilogram of the ingredient are needed. NIZO has achieved this, e.g., for natural peptides, proteins, enzymes and vitamins.

CONTINUE ON PAGE 3

Quest International creates and markets flavours, food ingredients and fragrance formulations. We find its products in a huge range of goods, from foods, snacks and beverages, to exclusive scents. The company is part of the ICI Group, one of the world's largest producers of specialty chemicals.



AN INTERVIEW WITH
PETER DAVIDSON FROM QUEST
INTERNATIONAL

Generating solutions is what it's all about

When responsible for ICI's Process Engineering, at the age of 38, Peter Davidson caused a stir by being elected the youngest-ever fellow of the famous British Royal Academy of Engineers. Today, he still holds the record. Perhaps it is typical of Davidson's strong interest in finding solutions to real problems, as well as his scientific drive, that he didn't choose an academic environment to nurture and develop his skills. Instead, we now find him at the head of the technical function in Quest Foods located in Naarden. Under his leadership, some 500 skilled scientists, technologists, and engineers carry out pioneering research on taste and texture, on new ingredients and formulations in Quest branches all over the world.

INNOVATION IS ESSENTIAL

"We generate solutions; that's what we're here for," says Peter Davidson. "Our scientists are among the world leaders in their fields of expertise. Part of my job is to encourage individuals from

around the world to work together, so that Quest's customers can profit from our global capabilities. In our business, innovation is essential," says Davidson. "Most of it we do ourselves, but for some specific contract research we rely on a partner like NIZO food research. Their expertise and background provides them with strengths in lactobacillus cultures and other related fields. Look at the compatibility of our organisations: we're both interested in taste and texture, and in satisfying consumer needs. I'm also impressed by their ability to integrate ideas, and their project-management skills."

Quest operates in a branch that is highly competitive and pioneering. "Partners in contract-research must be very aware of that," says Davidson. "NIZO also learns from the research they do for us, so the element of confidentiality is not to be taken lightly. Although they've always handled it well, we will keep emphasizing this aspect of our co-operation."

UNPARALLELED MOMENTUM

"The science of taste and smell has a long way to go. But our understanding is developing fast. To give you an example, we now work together with a Californian biotechnology company to help us understand the genetic foundations of taste and smell. This alliance has already proved successful. The human genome project has allowed us to get vital knowledge about the type and number of receptors a human being uses for taste and smell. To us, this knowledge provides the potential for a series of major breakthroughs. When you put these findings together with developments in IT and material science, which are some of ICI's strengths, you get a cocktail that provides the chance for a step change in our capability for satisfying our customer needs. The next few years has the potential to be exciting times indeed for our Industry." I would hope that jointly we will enjoy the thrill of a successful collaboration.

NIZO FOOD RESEARCH NOMINATED FOR Fi RESEARCH AWARD

NIZO food research will be prominent at the Food ingredients Europe (Fi) exhibition in London, 5-7 November.

This year, again, four papers from NIZO on innovative applied research have been selected for presentation during the Fi Food Summit. In addition, NIZO has been nominated for the prestigious Food ingredient Research Award, with its research on 'Measuring flavour release in real time and in vivo'. This is not the first time. At the 1999 Fi in Paris, an unprecedented winning of two awards was achieved.



You are of course welcome to visit us at stand no. B104. In our booth you will find out all about the latest innovations and developments on flavour, texture, health, quality & safety, and processing research, and of course about our pilot plant facilities.

PRESENTATIONS:

MONDAY 5TH

- A new optical tool for in-line monitoring of texture

TUESDAY 6TH

- A new generation of encapsulates.
- Revolutionary "Fresh&Safe" UHT technology

WEDNESDAY 7TH

- Flavour research for innovations in fermented food products

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HIGH QUALITY

The first step towards safe food products

The challenge for the food industry is to produce high quality, safe foods and at the same time provide long shelf life and good taste. This calls for control of microbial spoilage taking the whole food production chain into account. The NIZO services are increasingly solicited to achieve microbiologically safe ingredients because the dynamics of bacterial spores, still a major hurdle in the food industry, are well understood by NIZO.

Since these spores are ubiquitous in nature, raw materials of plant and animal origin are contaminated. Spores are heat resistant and thus may survive during food processing like UHT treatment. Subsequent outgrowth in final products

leads to spoilage or can even cause illness. Cocoa, for example, is naturally contaminated with low levels of Bacillus spores. In chocolate milk the spores surviving processing can grow out to high levels and lead to defects in product structure, resulting in reduced shelf life. *Alicyclobacillus* spores occur, e.g., in fruit concentrates and ingredients such as pectins, glucose syrups. They cause off-flavours in fruit juices and fruit juice containing drinks.

NIZO food research has developed DNA-based detection methods for *Salmonella*, *Listeria*, *Bacillus*, *Clostridium* species and predictive

models, and has a complete range of facilities. This, combined with unique product and process knowledge, enables us to advise customers in producing safe products. We can identify spore-forming organisms and spore populations and characterise spores with respect to relevant properties like heat-resistance. Furthermore, our tools and expertise enable the food processors to prevent spoilage by adaptation of the product composition and heat-treatments and to predict the behaviour of spores in final products. This results in faster product development, more effective heat inactivation processes, improved quality and prolonged shelf life.

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CONTINUATION OF COVER STORY FOOD VALORISATION

Three main steps are usually involved:

- Development of a lab-process to prepare and isolate the active ingredient (including steps like hydrolysis and fermentation), and set-up of methods for analysis.
- Optimization and up-scaling of the process (e.g., by membrane concentration and separation, chromatography, crystallisation).
- Actual manufacturing of the ingredient for health studies.

ESSENTIAL NUTRITIONAL TRIALS

Once the active ingredient is produced on kilogram scale, NIZO can also do the essential nutritional trials to prove efficacy. This basically allows for one-stop-shopping resulting in a

significant reduction in the development time.

An example of testing an active health ingredient is the effect of antioxidants against oxidative stress. In rat experiments, we showed that dietary antioxidants resulted in reduced damage to living cells. The next step will be human trials. Results will independently and scientifically support the health claim, to be attributed to a new product. It is evident that long-standing experience allows for the most optimal design of nutritional studies, balancing time, money and nutritional evidence.

SCALE-UP FOR TEST MARKETS

By purifying the health component and proving its efficacy, one does not yet have a

commercial product. An industrial process needs to be developed. Scale-up studies of the developed process are carried out in the food-grade NIZO pilot plant. The facility can also be used as a production unit for test markets. This means one can delay significant investments until success in the market place has been proven. Moreover, as new processes need some time before all start-up troubles have been overcome, it is attractive to

have NIZO experts accompany this critical part of the production start-up.

So, if you have a dream about 'gold' in your raw materials: set our food valorisation team to work and find out if your dream can come true.

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FOOD SENSE

NIZO Food Sense a new generation gas analyser for the food industry

Based on a new generation of gas analysers developed by V&F (www.vandf.com), NIZO food research is currently introducing a new technology to the world-wide food and ingredient industry in an exclusive partnership with V&F. The basis of this gas analyser is a unique and patented ionisation concept resulting in a high sensitivity and selectivity. This concept allows real-time gas analyses with ultra-low detection limits (<< ppb level) for volatile compounds in a mobile unit, using only electricity.

An example, illustrating the value of this technology in quality control of liquid products, is the immediate detection of unwanted compounds (e.g., chloroform) generated by residuals from cleaning agents. Our data shows that the NIZO Food Sense can measure chloroform

at 2 ppb level in liquids, which relates to residuals of chlorine containing cleaning agents of 0.007% of active chlorine. By implementing this gas analyser in a manufacturing process, the risk of introducing cleaning agents in liquid foods can be minimised to almost zero.

Illustrative of its power as a tool in product development and R&D is the sensitive detection (ppb level) of the sulphur allyl volatiles (e.g., dimethyl sulphide, H₂S, etc.) characteristic for flavours such as onions, cheese and garlic. This technique has a high potential as a valuable tool for R&D and process control in the food industry. We invite you to discuss with us possible applications of the NIZO Food Sense in your company.

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RHEOLIGHT:
A new instrument to monitor Texture & Stability

Texture and stability are important criteria for acceptance of food products. NIZO food research has developed the NIZO RheoLight (also known as DWS), a powerful new tool based on laser technology, to monitor texture development and to predict the stability of your product both during processing and in the lab. The use of laser technology makes it a non-destructive tool, without the need for sample preparation, and applicable in a broad temperature range.

The NIZO RheoLight was originally developed to monitor curd formation during cheese manufacturing. Its application has been broadened to measure rheology in any turbid system such as desserts, drinks, sauces, mayonnaise, toothpaste etc. The NIZO in-line RheoLight has been successfully installed in several cheese factories where it contributes significantly to cheese yield and process control. Recently, also a lab

version has been introduced, which is fully computer controlled, and can be used to measure rheological parameters such as viscosity, gel time and structure development in applications (e.g. yoghurt, desserts, mayonnaise). It is easy to handle and simple in its use. NIZO food research has an instrument available for your evaluation and could always advise you on the potential value for your application.

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RHEOLIGHT: SIGNIFICANT CONTRIBUTOR TO CHEESE YIELD AND PROCESS CONTROL

Unraveling the 'touch and feel' of taste

Science has, long ago, uncovered the fact that the perception of flavour is linked to the detection of non-volatile flavour compounds by the tongue and volatile flavour compounds by the nose. A next step was discovering that in addition to flavour, the texture of a product also contributes to the overall appreciation by the consumer. But now, for the first time, scientists at NIZO food research have been able to quantify the effect of changes in texture components on flavour composition and perception. Moreover, this is achieved through direct measurements, i.e., in vivo! Dr. Alexandra Boelrijk heads a team of scientists who are breaking new ground to unravel the full story about how our perceptions of flavour and texture really interact.

NOMINATED FOR Fi RESEARCH AWARD

"There is a strong interaction between texture and flavour perception," stresses Alexandra. "We have found that by changing the texture, you can also change the intensity perception of taste." It appears that both sensory responses to flavour and texture are integrated in the brain to produce an overall perception of product quality. This can now be measured by 'in vivo' (direct human) measurement techniques. "In fact, we have been nominated for the prestigious Fi research award on this topic, which will be granted at the Food Summit during the Food Ingredients Exhibition in London".

KEY FLAVOURS

"It all starts with finding the most important flavour markers in a product to give us a handle for further research," says Alexandra, as she takes time to explain the procedure, named SOIR, used by NIZO food research to determine 'key flavours'.

"Once you have them, you know what makes the flavour of a specific product so special. The 'SOIR' procedure is short for the four stages of Sensory Evaluation, Olfactometry, Identification, and Recombination. It has been successfully applied by NIZO food research to a variety of food products. Olfactometry, which uses the nose of a flavour expert as a detector behind the gaschromatograph, is used routinely at NIZO to identify those flavour molecules that have the largest impact in a mix of numerous flavour molecules that are generally present in a complex product.

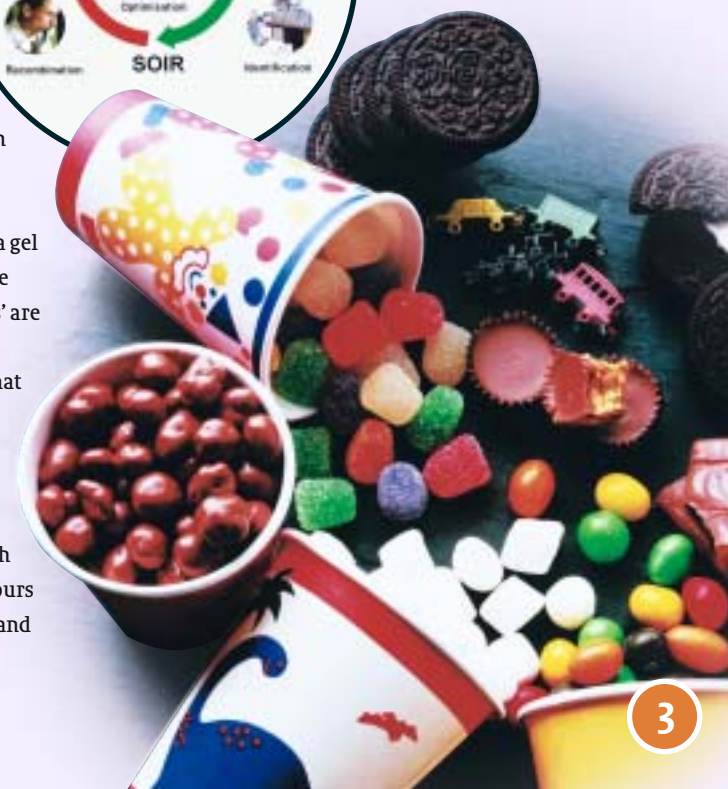
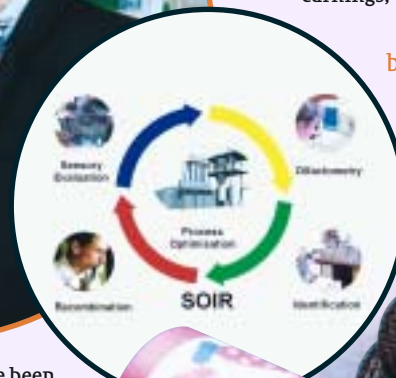
NIZO TAKES IT FURTHER

Once you have determined the key flavours of a product by olfactometry, recombination experiments are done to check whether all

important flavour molecules have been identified. The recombination stage is where the key aroma components are added proportionally to a matrix (e.g., a gel or water/alcohol mixture) similar to the product. The resulting 'sensory models' are then evaluated by a panel. They judge whether or not the flavour sensation that was perceived earlier in the original product is reproduced. On its own, the SOIR procedure produces important results that characterise the flavour of a food product." But NIZO food research takes it further. "Knowing the key flavours opens a world of possibilities to control and

modified product quality," emphasises Alexandra. "Based on the key flavours, ingredients and processes can be efficiently optimised to suit the client's aims. We are able to couple our flavour analysis with our sound knowledge of flavour and texture-forming processes in fermentation. Knowledge of key flavours and skills in the manipulation of texture and flavour can have a significant impact on the quality and cost of a product, and consequently on the company's earnings," concludes Alexandra.

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CEES DE JONG

Since DMV released the news of a joint venture with Farmland National Beef, Cees de Jong has been busier than ever. The American company has found a way to enhance the effect of the bioactive milk component, lactoferrin, a hundred to a thousand times. The discovery that lactoferrin is a well-known bacteria killer, made it possible to use this relatively expensive substance to disinfect large quantities of meat. Farmland now needed lactoferrin, and preferably in large quantities. That is when they contacted DMV International.

CHEESED-OFF WITH ILL HEALTH?

Being the sole nourishment of newly born mammals, nature has blessed milk with numerous valuable characteristics. Take cow's milk for instance. One can make butter out of it, or cheese, or yoghurt. You can drink it and experience its full nutritional value. But you can also look upon milk as a source of healthy and active ingredients. That's the core business of DMV International in Veghel, which is part of Campina. Or, as managing director Cees de Jong puts it, "We tear milk apart."

Discover the treasures of milk

30 OTHER MINOR COMPONENTS

With 3 billion kilos of milk and whey running through its pipelines every year, DMV is one of the biggest processors of skimmed milk in the world. One of the major products is lactose, which is used to provide 'body' to pills and powders. More than 40 percent of all the pharmaceutical lactose that is used world-wide comes from the factory in Veghel, Holland. But DMV also produces caseinates and calcium.

Most of these substances are extracted for their nutritional or functional value. Only lactoferrin and lactoperoxidase are known to be bioactive. "Bio-active substances are much harder to detect and extract", says Cees de Jong. "While we can get 51 grams of lactose out of one kilo of milk, we can only extract 0.01 gram of

lactoperoxidase. And we know that milk carries about 30 other minor components, for which not all the bioactive functions have even been determined yet. But we're actively working to change that. At this moment, DMV focuses on finding and isolating minor components, and on determining whether or not there's any commercial value in them. NIZO food research helps in this process by doing fundamental research."

FOOD SUPPLEMENTS

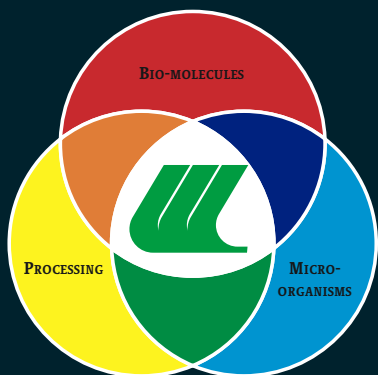
For the future, the Managing Director sees a growing role for natural bioactive ingredients. "Over recent years, 40 million kilos of meat was recalled in the United States alone. Our own market research reveals that 70 percent of the American consumers are 'very', or 'extremely' concerned about the quality of their food and

they're prepared to pay for safety. Ingredients like lactoferrin can fulfil this need, especially since it is a natural substance, for which no genetic manipulation is needed."

Other bioactive ingredients may be used in food supplements. Cees de Jong expects Europe will see a lot of those in the years to come. "Food supplements for the benefit of the heart, the bones or to build resistance to ailments are very common in the U.S. and Japan. Europe is bound to follow, especially since populations are living longer and the standard of living increases. In these sorts of products, we will rediscover all the wholesome ingredients of milk. The only difference between food supplements and the traditional glass of milk we have before going to bed is that concentrations are higher, and thus more effective."

NIZO FOOD RESEARCH'S LEADING AREAS OF EXPERTISE:

- BIO-MOLECULES**
 - Texture and stability
 - Emulsions
 - Enzymatic modification
 - Analysis
- PROCESSING**
 - Predictive modelling
 - Separation and drying
 - Fermentation and inactivation
 - Pilot plant
- MICRO-ORGANISMS**
 - Flavour
 - Food Safety
 - Metabolic engineering
 - Health
 - Culture collection



Texture of PRIME importance for consumers

How can I replace a fatty with a non-fatty ingredient? Can I decrease the heat load on my product? How can I encapsulate my flavour compound with a cheaper protein? These are typical questions from our customers. The answer is usually a compromise between costs, processing facilities and the desired texture, mouthfeel and flavour. The strength of NIZO food research in solving these problems lies in a fundamental understanding of food physics and biochemistry on the mesoscopic level, combined with more than 50 years experience in food technology applications.

OPTIMAL SOLUTION

Although each problem is unique, the road to solve it is often the same. NIZO food research has developed the PRIME-approach. It starts with unravelling the customer's question in a description of the consumer Perception of the food attributes. These attributes are translated into Rheological and structural parameters in relation to the used Ingredients and finally to the behaviour of the responsible MoleculE. With PRIME we systematically arrive at the heart of the question in a way that is clear and logical, and come to the optimal solution.

MOUTHFEEL

Clearly, product texture and stability are of prime importance, but how to determine them is not so evident. We start our analysis of a product on the macroscopic level. Here we use trained panels but also rheometers, confocal microscopes, texture analysers and the food grade pilot plant. At the macroscopic level we look at aspects such as colour, mouthfeel, sandiness, syneresis and texture.

MESOSCOPIC STRUCTURES

In the next step we use the key expertise of NIZO food research in understanding the mesoscopic structures. These structures are smaller than can be seen by the eye, but are larger than molecules. Typical examples are the type of the network formed, the size of the pores in a gel, or the size and shape of the particles that result

from interactions between proteins and polysaccharides. These features really determine what is going on in a product. For instance, the long-term stability or instability of UHT sterilised products can be understood from their mesoscopic properties. This allows our customer to select the proper ingredient and concentration of a stabilising agent. We have a world-wide reputation for our expertise in different optical and scattering techniques to determine the size and shape of particles on this length scale.

We were among the first to acquire a Confocal Microscope (CSLM) that is solely dedicated to the analysis of food structures. It is used to visualise structure, but also the interaction between ingredients. We can, e.g., visualise carrageenan networks in dairy deserts and relate the variation in processing to differences in structure that determine the final product properties. This allows our customers to efficiently screen and adjust their ingredients.

MOLECULAR LEVEL

It appears that solutions for texture, viscosity and stability control can often be found at the mesoscopic level. But sometimes that is not

enough and we need to perform studies on the molecular level to solve a specific problem. For this, chromatography, NMR and mass spectrometry and other techniques are available at NIZO food research. PRIME is an integrated approach. In a typical project team, scientists from several disciplines work together to answer customer's questions in a cost-efficient manner. This is why NIZO food research can offer the PRIME solution in food texture and stability.

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Calendar of events

- NOVEMBER 5-7 | Presentation of NIZO food research innovations. at Food ingredients Europe (Fi), Excel int. Exhibition Centre, London.
- NOVEMBER 16 | Open NIZO Lecture entitled 'Nutrition & natural defence' by Dr. Hans Snel at NIZO food research, Ede
- DECEMBER 14 | Open NIZO Lecture entitled 'Powder technology: targeting at functionality' by Ir. Ruud Verdurmen at NIZO food research, Ede
- JANUARY 25 | Open NIZO Lecture entitled 'The NIZO RheoLight, a revolutionary tool for monitoring texture and stability' at NIZO food research, Ede
- MARCH 22 | Open NIZO Lecture. Title to be determined. at NIZO food research, Ede
- MAY 17 | Open NIZO Lecture entitled 'Sensors: future monitoring tool for Cleaning in Place (CIP)' at NIZO food research, Ede

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