

Safety

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Food safety is a major topic in the public debate. Newspapers, politicians, everybody has an opinion on it. For society and industry alike, it is essential that the debate can be based on facts rather than emotions. Not so long ago, when we talked about 'food safety', we considered the quality of the food as it could be purchased in the shop. Now, we know that for giving a sound judgement about the safety of a product, we need to involve knowledge of the entire production chain. In the case of dairy products, that means from feed to milk carton. As we already know a lot about the end product and about industrial processes, NIZO food research has been focusing its attention more upstream in the supply chain: on the farm.

Assuring food safety through control of the dairy supply chain

The project 'Measurable quality of raw milk' was initiated some years ago in discussion between the Dutch dairy industry and NIZO food research. "The project follows a long Dutch tradition, as the dairy supply chain has been the best monitored food sector for decades," says Dr. Meike te Giffel, who is the project leader of the Joint Research Program, an extensive research program on dairy that is initiated and financed by the joint dairy organisations in the Netherlands, and of which the 'Measurable quality of raw milk' project is an important part.

It means scientific pioneering because it goes beyond conventional methods of control. "We don't just look for new methods to analyse contaminants and residues; we develop predictive models that actually describe the process that is the subject of our investigation. That way we are not dependent on what we can measure, but we can calculate and predict events in the food chain. Thus, we can design processes and optimise

the products by changing the production parameters," adds Meike. The project has already revealed many important factors in animal husbandry influencing the quality of raw milk and processed dairy products.

According to Meike te Giffel, the research team has even turned a farm into a model. Figuratively speaking, of course. "Put simply, you put feed in and milk comes out. But how does it work? What happens exactly? If you can answer these questions, you can, for example, try to change the composition of fatty acids in milk by adjusting the diet of the cow. That way, we can provide important extra tools to influence product quality."

DOWN ON THE FARM

The project team does not restrict its efforts to new knowledge; it brings its knowledge to the application. A fine example is the development of a new method for determining residues of antibiotics in milk. "When a cow is treated with antibiotics, its milk has to be kept



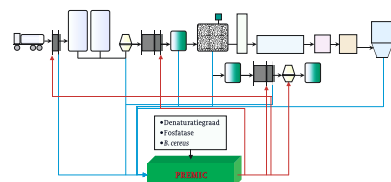
DR. MEIKE TE GIFFEL

out of the milk tank for a prescribed amount of time after the treatment with antibiotics is stopped, i.e., until it can be assumed that the cow produces uncontaminated milk again. In some cases, however, this time span isn't long enough. In such cases, it is possible that antibiotics contaminate the entire milk supply, and the farmer is cut back on the milk price. With our new method of determination, we can determine residual antibiotics quickly on the farm itself. So, a farmer can rely on facts. This way, we succeeded in tightening the security net around the production of dairy even further." ▶

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Breakthrough in process control

Food processes are increasingly automated to reduce production cost and enhance reproducibility of processes. Today, process control systems are common practice in every factory.

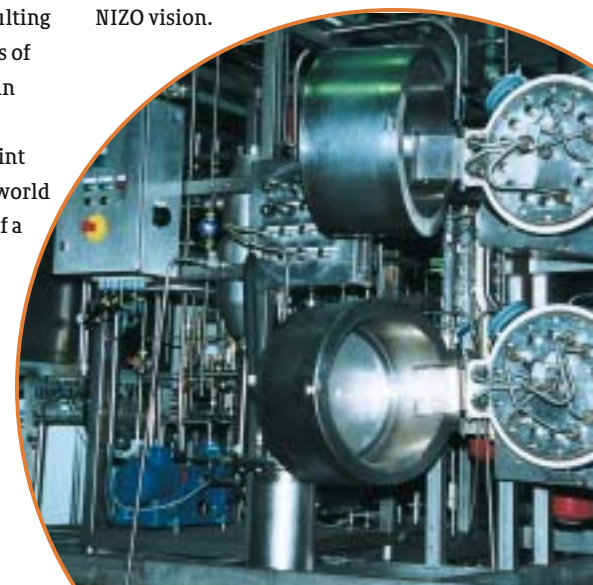


Control systems measure parameters like temperature, pressure and flow, which is an indirect way of measuring the quality of the food. It would, however, be much better to control food processing by using direct quality parameters, like taste, viscosity, etc.

For 15 years now NIZO food research has been involved in the development of exactly these types of models, many of which have been applied with great success in industry, sometimes resulting in the reduction of production costs of up to 20%, as well as improvement in product quality.

The most recent instance is a joint development with Honeywell, the world leader in process control systems, of a process control system for the food industry along the lines described above. In this way, the product and process knowledge of NIZO food research is integrated with the process control experience of Honeywell, delivering benefits for

the entire food industry. A first prototype is expected to be ready for testing by the end of 2002. More details will be discussed in a next edition of NIZO vision.



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In our modern society we believe everything is possible. Miracles of modern technology has put man on the moon, extended the life of people and improved the quality of life enormously. After years of abundant economic growth and scientific progress, we no longer accept imperfection. This is one of the reasons why food safety issues continue to dominate the public debate.



In addition, the population structure as well as living habits and food consumption patterns are changing. As a side effect of the increased life expectancy there is an increase in the number of vulnerable elderly people and vulnerable children. Furthermore, increased global trade and travel leads to more exposure to new foods and or possible sources of infection. Reversal of the food chain leads to increased economic pressure and changes in production methods, not all of which are done with the optimal expertise.

Although overall food safety is better than ever, the number of food scares in recent years has led to a loss of the public trust in food authorities, governments and industry alike. Especially in times when emotions are running high, it is of crucial importance that the discussion is based on facts. Sound, validated scientific proof is needed.

While consumers and governments can stop at formulating their requests, the challenge for industry is to realise the vision, in combination with good taste, long shelf life and other product properties. Addressing the issue of microbial and chemical safety requires a systematic approach of the whole food chain, from raw materials and food ingredients via processing to final products. In this NIZO Vision, we illustrate how NIZO tools and expertise is helping to meet this challenge.

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CONTINUATION OF COVER STORY ASSURING FOOD SAFETY

WIDE-RANGING PROJECT

The project is of great importance to NIZO food research. One in every four scientists at NIZO contributes his expertise to the project on a regular basis. Meike te Giffel: "It is a very wide-ranging project in which chemical and microbial analyses and product properties play an important role. The project touches our entire knowledge-range, which is why all the departments within this organisation are involved in it." The research for 'Measurable quality of raw milk' is representative of the way NIZO food research works in very close contact with its partners in the food industry. The work is guided by a working group in which experts from the Dutch Dairy Organisation (NZO) are represented, and by the program council.

"They evaluate our results and together we decide on the direction in which our research should be heading. That's how we make sure that our work is relevant to the dairy industry," says Meike te Giffel.

CRISIS MANAGEMENT

In addition to being a platform for fundamental research, the project also provides



a good base for answering any ad hoc questions that may arise in the dairy sector. This has proven extremely useful, especially in times of crisis. "During the recent foot-and-mouth disease-crisis in our country, we received a lot of questions about whether or not a specific production process would be sufficient to inactivate the virus. By analysing the given process, as well as combining knowledge of microbiology, product and process characteristics and predictive models, we have been able to provide quick answers. These were subsequently integrated in a fact sheet that gave a quick overview for our industry partners. To us, providing quick answers to ad hoc questions is also a fundamental part of this project. Food safety is a matter of expert knowledge: taking responsibility for prevention and good production, and being able to mobilise all knowledge in the event of a crisis. That is what we are here for!"

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Analytical 'tour de force'

THE RIGHT PRODUCT-ANALYSIS COMBINATION

When dealing with quality and safety of food and ingredients, first-rate analysis of components is a vital tool. This requires access to modern equipment and well-trained people. A good analysis depends on thorough knowledge of products and the ability to judge which combination of sample treatment and measurement system has to be employed. This encapsulates the uniqueness of NIZO food research. Based on long experience with foods and food processing, NIZO food research knows which tools should be used to guarantee correct answers to clients' questions. A typical example is the ratio of caseins and serum proteins in heat-treated dairy products, e.g., baby foods. Due to denaturation of part of the proteins, application of a standard method gives totally wrong results.

BIOSENSORS

Quick analysis of wanted and unwanted components is required in many food processes. For this reason, the search for quicker and more specific methods is continuous. An emerging technology is the application of biosensors.

In brief, a biosensor makes use of analogous processes, as take place in living organisms. Due to the reaction between the component that has to be measured and a receptor or an antibody,



the medium changes. These changes are calculated as a function of the concentration. The whole process can take place 'on-chip', which allows the method to be automated. First results indicate that components, such as mycotoxins and antibiotics in food products, can be measured in a quick and reliable way. Also, positive components, such as vitamins, are being worked on.

NIZO food research participates in a network of research institutes to develop applications for the food industry.

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Food safety in The Netherlands is the concern of many organisations, each playing their own specific role. Although their scientific expertise is usually very high, the whole mechanism of legislation and exercising control is handicapped by the variety of this landscape. The Dutch Food Authority (NVA), an organisation that is currently being founded, should make an end to that by closely directing and supervising all food safety activities in the realms of research, control and communication.

"Dutch Food Authority poised to become fully operational"



DR. WIM DE WIT

The immediate reason for creating the NVA is the foundation of the European Food Administration (EFA), which is quickly taking shape. In February, the members of the European Council agreed (in Nice) on the main task of the EFA, which is: giving scientific and technical support for legislation and the policy of the EU on all fields that directly or indirectly influence the safety of the food chain.

The EFA led to initiatives for national food administrations in most member states. Being a country with enormous interests in the food producing industry, The Netherlands took a leading position in this process. This year, on July 13th, the NVA received an official 'go ahead' from the council of ministers. Its first director is Prof. Dr. Ir. Wim de Wit. We spoke to him at his office in The Hague.

Could you explain the timing for the founding of the EFA and the NVA?

"We witnessed some serious food safety crises over the last ten years, some on a European scale, others within the borders of our own country. The Beerenschot Committee, which evaluated these crises in The Netherlands, concluded that they were managed fairly well. However, in the field of lawmaking and inspection, there were impediments caused by the fact that there are many players without proper coordination between them. The NVA may be considered an answer to that problem."

At what stage in its founding process is the NVA?

"We will be an official organisation once the 'law on the NVA' has been passed. That will be a matter for the next government. But, since the Council of Ministers considers the NVA a matter of high priority, it has issued a directive that enables us to become fully operational now. At this moment, we're forming our new organisation, and we expect to be able to perform our tasks very

soon. Since the Dutch parliament unanimously supports the NVA, we don't foresee any political difficulties in the future, so we can gradually grow into an 'official' NVA. I expect the law on the NVA to be passed sometime next year. From the swiftness of the process, one may conclude that food safety is very, very high on the political agenda."

What are the tasks of the NVA?

"We have three major tasks: research, inspection and communication. Research means trying to locate safety flaws in the production chain. Determining how harmful certain substances are, what the consequences are of stacking residues, and similar things. For this research we'll make use of the expertise of Rikilt and the Government Agency for Public Health and Environmental Hygiene (RIVM), which will act as our own research organisation. In addition, we'll work with other organisations, like NIZO food research, on a contract-basis. In the discussion on food safety, expertise like that of NIZO food research and other research

organisations can play an important role in providing facts.

In the realm of inspection, we'll also work with existing organisations like the Government Agency for the Inspection of Cattle and Meat (RVV), Food Wares Inspection Agency (Keuringsdienst van Waren), the Central Organ for Quality Issues in Dairy (COKZ), and some others. The NVA has the authority to make sure that the tasks of these organisations are well tuned. We also have the authority to monitor these organisations regarding their way of working. I specifically say this because there have already been some critics who stated that we wouldn't have any influence on the operations of these organisations. But that's not correct, because we do.

With regards to our third task, communication: the NVA is not only expected to report the results of research to the public, we will also play a communication role whenever there is a food-safety crisis."

Protection against bacterial infections via food and feed

Each year, millions of people suffer from food-borne infectious diseases worldwide. Most cases are associated with foods of animal origin, e.g., meat products contaminated with *Campylobacter*, *Salmonella*, or *E. coli* O157: H7. These pathogenic micro-organisms are naturally present in the intestinal microflora of poultry, pigs and cows, and rarely cause disease in these animals.

NIZO food research applies infection models in combination with molecular techniques to determine the efficacy of food ingredients or food products against infection with *Listeria*, *Salmonella*, and *E. coli* O157: H7. Already, the addition of phospholipids as ingredients or calcium enrichment of feed indicates that rats can be protected from infectious disease.

In cooperation with the feed industry, NIZO food research investigates the possibilities to apply similar concepts to suppress bacterial infections in animals. This opens the way for testing in other products.

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Since the first blueprints for the NVA have been presented, the comparison has been made with the American Food and Drug Administration (FDA). In which ways do these organisations resemble each other?

"In a lot of ways, but there are also some notable differences.

First, we focus on all the production chains, while the FDA has no saying in the fields of meat, eggs and poultry. Second, while we can advise the government about laws in the field of food safety, the FDA can actually make laws themselves. Third, the FDA is accepted as an authority by the consumers. We will try to achieve the same, of course, but European citizens are usually more critical about authority, so, certain differences are bound to remain in that field."

Should food-producing companies start worrying?

"Companies that endanger public health by being careless and by not taking the law seriously certainly should. But, fortunately, we're talking about a very small percentage of the food producing industry. In this field, we mostly deal with large industries that are very conscious of the fact that food safety is in their own interest. They have most of the risks already covered by advanced quality systems. These companies probably welcome the NVA because it means an important step towards levelling the playing field, so everybody will have to observe the same safety standard. The industry will also welcome more efficient controlling mechanisms, which is one of our goals. And, the NVA will, of course, enhance public trust in food products, which is in everybody's interest."

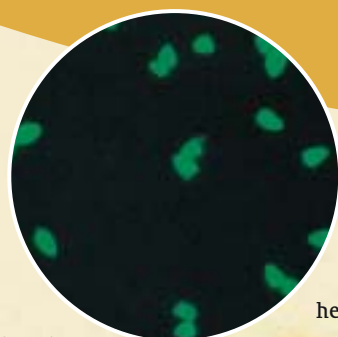
It is vital to detect micro-organisms that can spoil or even make food products dangerous to animal and human health. At the same time, it is also important to determine whether micro-organisms with essential and beneficial properties are present in food. NIZO food research is at the forefront in developing and using cutting-edge techniques to detect and identify micro-organisms in food and feed.



MOLECULAR DIAGNOSTICS:

Food detectives in search of:

'the good, the bad and the ugly'



When it comes to tracking down and identifying micro-organisms, molecular biologist Jan Rademaker, is NIZO food research's resident 'detective'. "Detection and identification of microbes which have beneficial effects, or are responsible for spoilage and disease, is comparable to looking for the good, the bad and the ugly," says Jan, drawing his analogy from the classic Clint Eastwood western movie. Obviously, the presence of pathogenic bacteria in food and feed will make people and animals sick, 'the bad'. "Without certain micro-organisms, 'the good', we could not produce wine or beer, yoghurt or cheese". By a process of elimination, 'the ugly' must be the so-called spoilage microbes. These are the ones that make food products go 'off', or at least, not to taste as they should.

"The traditional approach for detection and identification of micro-organisms up to strain level can be a slow process that takes days, weeks, or even months. Modern molecular techniques have the capacity to speed up the whole process." So, in addition to the traditional microbiological and biochemical methods at its disposal, NIZO food research employs molecular techniques, such as PCR (Polymerase Chain Reaction). PCR is considered a core technique that is proving to be the fastest way of detecting very low concentra-

Jan brings some excellent academic credentials to his job, and, talking to him, he made the subject seem as easy as ABC.

"DNA fingerprinting is simply using a reflection of the bacterial genome in the form of a barcode for identification," he says. DNA is a molecule that has specific parts unique to each kind of living organism. "Bacteria are normally cultivated to obtain more material after a period of time enabling identification," continues Jan. "But when the microbe can't be grown, or there is no time to grow it, DNA fingerprinting gives a rapid, specific and reliable alternative".

DETECTION, QUANTIFICATION AND IDENTIFICATION OF MICROBES

Jan's group is involved in three categories of analysis: detecting and quantifying microbes, identifying them, and analysing their diversity. NIZO food research offers rapid and specific techniques for detection and quantification of beneficial microbes, as well as spoilage and pathogenic microbes.

There's more to this work than just detecting and identifying a microbe. DNA fingerprinting helps to solve the problem just like screening a population to find a criminal or a generous contributor! It provides a powerful tool for food detectives who have very little visible evidence to go on.

at group, species or strain level. The analysis of microbial populations has enabled the dairy industry to study the stability of starter cultures during production and ripening of cheese, and to influence taste and structure. Diversity analyses are also applied to study the effectiveness of probiotics. "When people eat food with probiotics, it gets into their digestive tract. Diversity analysis can be used to determine the survival of a probiotic organism and to see whether one grows better than the other. Shifts in the microbial community can, thus, be followed. With respect to probiotics, the survival of probiotic organisms and activity in the gut can be determined to underpin the claims made by the producers.

The same technique is also used to characterise 'bad guys' in processing lines, where we are interested in finding the source of the spoilage organism. To track down contaminants, the similarities or differences between individual microbial DNA fingerprints are being used. "If a product is 'going off' you might want to know if it comes from an outside source, via air or packaging materials, or if it originates from processing, for example, via a difficult-to-clean place in equipment," says Jan. The tools described have successfully been applied, e.g., for specific and rapid detection of the micro-organisms causing late blowing in cheese (*Clostridium tyrobutyricum*), identification of, e.g., spore-forming organisms causing spoilage in a variety of heat-treated products or contamination sources in processing lines.

THE FOOD SUPPLY CHAIN

The goal in all of this is what Jan terms, 'a safe food chain from farm to fork'. Creating an environment where only the 'good' are present, while excluding 'the bad' and 'the ugly'. "Anyone can come to us when they want to improve their product quality, enhance its taste, or when they simply need a 'detective'," he concludes with a smile.



tions of micro-organisms, e.g., in food ingredients, such as pectins or soy fibers, and processed foods, from infant food to meat products. The method can also be used to detect the shift in the composition of mixtures of micro-organisms over time, like in starter cultures for cheese.

INDUSTRIAL APPLICATIONS

As a molecular biologist, Jan is particularly interested in the diversity of microbial populations, and how they mix and relate to each other. "We perform rapid and specific characterisation (typing) using DNA finger-prints. This is applied

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Food safety is an important theme at NIZO food research. The dairy sector is closely involved in the progress of the food safety program by means of a program council that guides and evaluates all joint research. In this council, all the major participants are represented: Campina Melkunie, Friesland Coberco Dairy Foods, the other dairy co-operatives, Nestlé and the Leerdammer Company, and, of course, NIZO food research. Chairman of the program council is Dr. Ger Willems, research & development director at Friesland Coberco in Leeuwarden.

NIZO Vision talked to him about the value of this project.

“Food safety: an area of vital concern”



DR. GER WILLEMS OF FRIESLAND COBERCO DAIRY FOODS: “WE’RE VERY SENSITIVE ABOUT WHAT WE GIVE OUR CHILDREN AND OURSELVES”

“In a lot of ways, people are generally less concerned with quality than before. Take clothing, for instance. We’d rather have something fashionable than something that will survive the decade. When it comes to food, however, it’s a different story. Food is an emotional subject and we’re very sensitive about what we, and our children, eat. It is so important to consumers that they consider safety to be a prerequisite. You can’t advertise by simply saying, ‘My food products are safe’. People would only smile and think: ‘Of course they’re safe, otherwise you couldn’t sell them, right?’ That puts us on the spot, because we invest heavily in safety without being able to use our success for marketing purposes.”

VEHICLE OF COOPERATION

“Another problem is that consumers abroad make no difference between brands or provinces within the Netherlands. So, if company ‘X’ in the province of ‘Y’ has a safety issue, the entire Dutch dairy sector is affected in the eyes of the consumers. Because of this, the sector has always been well aware of the fact that food safety is a vital common interest. The whole dairy sector works very closely together in this field and NIZO food research may be considered a major vehicle in this cooperation. We have several research projects going on at NIZO food research, which are shared by the dairy sector, but the project ‘Measurable quality of raw milk’ is by far the most important one”. This project was initiated five years ago by the joint Dutch dairy sector. It has already generated a lot of new data and useful methods and models to further improve the safety of products.

UNDERSTANDING THE RISKS

“This project has two objectives. One can be described as a ‘defensive objective’. Its main goal is to secure product quality by developing predictive models and methods for analysis of contaminants. The project concentrates on the whole production chain and the main focus is on raw milk. It is, for instance, not enough to recognize bacteria; we want to know where they came from and how they got there. Only if you have a thorough understanding of what is happening you can truly understand the risks involved and take appropriate measures.

The other objective is the pro-active one, for which you set out to discover what good components are present in milk and how they can be increased. Let us consider, for instance, folic acid. It might be interesting to find out if the concentration can be influenced, resulting in enhanced levels. Of course, you first have to make sure that there’s a demand for milk that is naturally enriched with folic acid, otherwise you might as well add some of it yourself and do it the easy way. If you decide to pursue natural enrichment, you might end up in the field of cattle breeding or the feeding regime of the cows.”

CONCENTRATING ON CORE COMPETENCIES

“As you can see, modern research methods almost automatically drive scientists to the boundaries of their field of expertise. That is why it is so important to work together in a network of scientific institutions. Not so long ago, most scientific institutions were used to have their own territory, which they defended with vigour.

But as in the business community, this old structure has made way for a new way of thinking in which ‘core competencies’ play a major part. You concentrate on what you’re good at, and leave the rest to others. NIZO food research understands this very well. To us manufacturers, NIZO food research is a central point in an extended network of scientific organisations. NIZO food research works closely together with them and thus creates valuable synergy.”

COMMERCIAL AS WELL AS SCIENTIFIC

“As a program council, we guide and evaluate the research that is performed in the ‘Measurable quality of raw milk’ project. This also applies to other joint projects. And, we not only assess the research by scientific standards. Don’t forget that the members represent food producing companies who solely exist by the grace of selling products. So, apart from asking ourselves what is scientifically possible, we are also concerned about the commercial relevance of any research initiative. After all, we are also here to optimise the output of the means we invest into this and the other projects. We need not be secretive about that.”

NIZO FOOD RESEARCH’S LEADING AREAS OF EXPERTISE:

BIO-MOLECULES

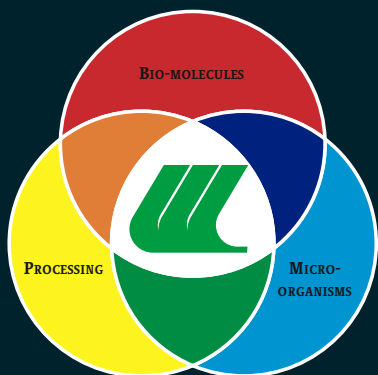
- Texture and stability
- Emulsions
- Enzymatic modification
- Analysis

PROCESSING

- Predictive modelling
- Separation and drying
- Fermentation and inactivation
- Pilot plant

MICRO-ORGANISMS

- Flavour
- Food Safety
- Metabolic engineering
- Health
- Culture collection



COMBINING THE MS NOSE™ AND AN ARTIFICIAL MOUTH

New boundary crossed in flavour research

Taste is the most important factor in the appreciation of food. Also, flavour is known to change during consumption. For more than two years now, NIZO food research has successfully used the MS Nose to study flavour release as one of the first institutes in the world. Traditional methods only measure flavour compounds in a static environment. The MS Nose measures the release of flavour compounds in the noses of panelists (in vivo) in real-time during the consumption of food. A new step in bringing technology closer to reality is the successful hyphenation between the MS Nose and the artificial mouth. This allows more systematic control of important ‘eating’ parameters and study of the breakdown of food-stuffs in a controlled and reproducible way. The MS Nose - artificial mouth combination is



ideally suited to study the relationship between food texture and flavour release. The combination of the MS Nose and the artificial mouth will accelerate the understanding of mechanisms involved in flavour - food matrix interactions.

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Calendar of events

- **October 5th** Open NIZO Lecture entitled ‘Food texture, how hard can it be?’ by Dr. Ronald Visschers at NIZO food research, Ede
- **October 30th & November 6th & 13th** GMV/SVML Course on Hygienic Design. Info from gmvf@fme.nl
- **November 5-7th** Presentation of NIZO food research innovations at Food Ingredients Europe (FIE), Excel int. Exhibition Centre, London,
- **November 7-8th** NIZO/Leatherhead Training ‘Novel preservation techniques’ at NIZO food research, Ede
- **November 13th** NIZO/Leatherhead Training ‘Milk as a source of ingredients’ at NIZO food research, Ede
- **November 14th** NIZO/Leatherhead Training ‘New developments in dairy products’ at NIZO food research, Ede
- **November 16th** Open NIZO lecture entitled ‘Nutrition and natural defence’ by Dr. Hans Snel at NIZO food research, Ede
- **December 14th** Open NIZO lecture entitled ‘Powder Technology: targeting functionality’ by Ir. Ruud Verdurmen at NIZO food research, Ede

FOR PARTICIPATION IN ANY OF THE ABOVE EVENTS CONTACT US AT: info@nizo.nl

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