

# Food & Biobased Research

Topics 2013

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Sustainable protein is the future

*Dutch regions embrace the biobased economy*

Aiming to reduce food waste by half

*Microalgae: Green gold*



FOOD & BIOBASED RESEARCH  
WAGENINGEN **UR**

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**Colophon** Publisher Wageningen UR **Project management** Wageningen UR, Communication Services **Interviews and text** Shirley Domingus, Jeroen van den Nieuwenhuizen **Translation** Writewell **Graphic design and photoresearch** Wageningen UR, Communication Services **Photography** Wageningen UR, Guy Ackermans, Hans Wolkers **Printing** MediaCenter BV, Rotterdam **Wageningen, May 2013**

# Wageningen UR Food & Biobased Research

## Companies are keen to partner with us

As a knowledge and research institution, Wageningen UR is an influential promoter of developments and innovations in sustainable and healthy food chains and the biobased economy, with the Food & Biobased Research institute being at its epicentre. 'An increasing number of businesses and knowledge partners in the Netherlands and abroad are discovering our added value with regard to sustainable chains and healthy products.'

Within Food & Biobased Research, Erik van Seventer is manager of the Biobased Products business unit. He and his colleagues are achieving sustainable breakthroughs in worldwide public-private partnerships or



via confidential bilateral projects with companies. 'Examples include projects focused on the production of chemicals, materials and energy from green raw materials,' Van Seventer explains. 'We are active in the Netherlands, as well as in other countries; from large-scale EU programmes to bilateral contract research for companies in the Far East, the US and Brazil.'

### Healthy and sustainable

Annemieke Beers heads the business unit Fresh, Food & Chains, which is involved in new sustainable technologies in the agro-production chain. 'We are increasingly succeeding in translating the state-of-the-art knowledge available at Wageningen UR into practical applications for clients' Beers says. 'Our approach varies. We offer smart technological solutions that make food chains more sustainable and allow companies to strengthen their position within the chain, but we also have extensive knowledge of consumer food selection behaviour and product development. This know-how is essential to continue to support companies looking to innovate. An increasing number of companies and knowledge partners in the Netherlands and abroad are discovering our added value with regard to sustainable chains and healthy products.'

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*'We support companies developing new production processes and biobased products'*

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### Cooperation

'Companies are keen to partner with us and respond positively to our work,' Van Seventer continues. 'We support them in the development of new production processes and biobased products, enabling them to shorten the period before they are introduced to the market.' 'It is a major benefit that we are part of a larger whole,' Beers adds. 'In the few square kilometres around us, we have access to a wealth of relevant knowledge and expertise.'

### Self-discovery

Van Seventer: 'I prefer it when companies themselves discover how we can help them. This edition of Topics shows that we are working hard to shape the future. We invite those inspired by these examples to contact us. Would love to discuss what we can do for one another.'



# Bioplastic PLA

## can compete with traditional plastics

Poly(lactic acid) (PLA) is one of the most important, well-known and commonly used bioplastics. PLA is 100% biobased and is currently produced from renewable raw materials like sugar cane or corn. Research at Food & Biobased Research aims at improving the properties of PLA and extending its applications. In consortia of companies and research institutes, as well as directly for industrial partners, scientists are developing PLA formulations with increased heat resistance and toughness. One of the results of this research is the heat-resistant PLA based coffee cup.

### Novel application options

PLA is an appealing example of a 100% biobased plastic material that is degradable in industrial composting facilities. It has an excellent ecological profile and is the most competitive bioplastic in various applications. PLA combines

*'Studies show that PLA can be a viable alternative for a wide range of applications, from coffee cups to high-quality products'*

good properties, such as high transparency, strength and stiffness, with characteristics that are less desirable in some applications. For instance, conventional PLA cannot be used at temperatures exceeding 55 degrees Celsius, is

relatively brittle and PLA films tear easily.

Within a framework of projects, scientists from Food & Biobased Research are examining options to improve the properties of PLA, for example via the use of specific additives or by adjusting the (plastic) conversion processes. In cooperation with lactic acid producer Purac, PLA formulations with a heat resistance up to 120 degrees Celsius have been developed. An example of a product that uses this technology is the biobased cup for coffee vending machines.

### Translating scientific knowledge

Within the Biobased Performance Materials program, Food & Biobased Research works with partners on methods to improve the properties of PLA via stretching or orientation. This is relevant for the production

of fibres, films, bottles and foamed products.

Biofoam™, an expandable bead foam based on PLA, was developed together with Synbra Technology partly based on this fundamental knowledge. Via a better insight in the behaviour of PLA during foaming, scientists are attempting to further reduce the foam density. In addition, oriented PLA is much tougher, and this knowledge is used in the development of PLA bottles that are transparent, heat resistant and less brittle.

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# Why international collaboration is so essential

New innovations based upon scientific discoveries are being implemented at a rapid pace. 'It is impossible to keep up if you isolate yourself from the rest of the world,' says Raoul Bino, Managing Director of Wageningen UR Food & Biobased Research. 'You have to work together.'

## How do you stay ahead of the competition if everyone is working together?

'You often hear people saying that a lot of knowledge is sitting on shelves. But knowledge on a shelf is outdated. In these days of tremendously fast global developments, it is impossible to build a competitive advantage on your own: Major investments and partnerships with other scientists from research organisations and industry are crucial. Together, partners can do pre-competitive research to speed up knowledge development and stay ahead of the game. All partners within the consortium benefit from this raised knowledge level.'

## How important is international collaboration?

'It's essential. While many of our

clients are in the Netherlands, countries like the United Kingdom and France will be equally important in the near future. For instance, in the biobased sector we work closely with the French company Total and in the public domain we have very close relations with the French National Institute for Agricultural Research (INRA) and the Institute of Food research (IFR) in the UK. We are working together in many EU projects and have joined forces in a bid for a European Knowledge and Innovation Centre on Food. Together we can achieve more than any of us could accomplish alone.' 'There is also a great deal of interest in our work from outside Europe. In China, for instance, we are designing a Metropolitan Food Cluster near the city of Beijing. And in Chile we are coordinating a large

collaborative programme with the food industry, knowledge institutes and the government to boost food innovations in that country.'

## How did a Dutch research institute end up coordinating a large project in Chile?

Food & Biobased Research has a long history of teaming up with private industry and governments, nationally and internationally. This has resulted in a continuous development of knowledge that can quickly be applied in new innovations. Being part of that process has played an important role for Wageningen UR in becoming a world leading institution in the field of agrifood. Chile wants to boost its food industry and looked around the globe for a partner with the proven ability to achieve that.'

### FUEL4ME

The year 2012 saw the start of a large-scale international algae project called FUEL4ME (Future European League for Microalgal Energy). A four-year project coordinated by Food & Biobased Research, FUEL4ME focuses on the use of second-generation biofuels as competitive alternatives to fossil fuels. As biofuel from microalgae has a higher density than the biofuel ethanol, it can be used in cars and well as ships, airplanes and trucks, without having to adapt the current infrastructure. FUEL4ME will compare and optimise continuous algae production for biofuels in different countries, among other things. It will also include research into the application possibilities for residues such as hydrogen, which can be used in the production of biofuel.

## But what about the physical distance?

'Research is the work of people, so it is imperative to regularly meet each other. Food & Biobased Research is therefore physically present in Santiago. The director of the consortium is permanently based there, and there are always several Wageningen UR scientists present in Chile. The same applies for other countries. Wageningen UR has offices in China and Brazil and is closely involved in projects in many African and Asian countries.

'Our people travel overseas, but international scientists also come to Wageningen. Such knowledge exchanges are beneficial to everyone. What we gain from working in countries such as Chile is very relevant for the Dutch agrifood sector too. For example, the ability to better control the hardness of avocados, a concern of the Chilean avocado industry, is also of interest to Dutch suppliers and avocado sellers. If everyone in the chain works together, we can collectively improve the end product.'

## What does Food & Biobased Research have to offer international partners?

'The combination of knowledge that we offer is our asset. We have technological expertise, carry out

consumer acceptance research and study the entire agrifood chain. For example, the development of a technology to enhance the shelf life of freshly squeezed juice requires microbiological and technological knowledge, but the taste and flavour of this juice is also being studied.

'The same applies for the development of innovative biobased products, such as chemicals and materials. Extracting proteins from microalgae without losing the functionality of these proteins requires a lot of knowledge of biorefinery. We want to use the raw material to its full potential, which means separating components that can be used in various production processes, reusing nutrients, reducing energy and water usage, et cetera.

'Biorefinery is a classic example of a challenge that requires collaboration from companies in a variety of sectors. While these sectors may previously have had little to do with each other, they now share an interest in the same raw materials. Companies from around the world are combining efforts to find solutions and Food & Biobased Research is pleased to be of assistance in this quest.'

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## WageningenUR/Chile

Chile is a major fruit exporter and the second largest exporter of salmon in the world. The country is also well-known for its wine. As it is the quality of its food production that sets Chile apart from its competitors, the country very much values the International Centre of Excellence WageningenUR/Chile. Established in the Chilean capital of Santiago in July 2012, this new knowledge centre brings together Chilean companies, the government and Wageningen UR. It focuses on healthy and attractive food which is produced in a sustainable way to stimulate the Chilean economy. The research consists of four major lines: Food Processing and Structuring, Consumer and Health, Food Safety and Supply Chain Sustainability.

The centre offers the perfect opportunity for joining the strengths of Chile and the Netherlands and making the most of the 'golden triangle' of industry, government and knowledge institutes.



## COFCO

Commissioned by the major Chinese food producer COFCO, Wageningen UR is working on the development of an Eco Valley. This 1000-hectare food-producing city located 40 kilometres from Beijing will be a comfortable home for 60,000 people surrounded by greenhouses, fields and grassland.

The project is based on the desire to combine living and recreation with sustainable food production. The increasingly rapid urbanisation in China (around half of all Chinese currently live in urban areas) has resulted in the challenge of providing all these city dwellers with sufficient good-quality, fresh food.

The commission by the Chinese company can mainly be attributed to the experience in designing agro-parks gained by Wageningen scientists over recent years. This is combined with the various tools developed over time that give insight into the local needs and specific situations.

# Car tyres made of dandelions and desert shrubs

Natural rubber is an essential ingredient for some 40,000 applications in industry, healthcare, transport and the defence sector. Demand has been increasing steeply over recent years, resulting in a more than fivefold rise in the price of rubber in a decade. This has, in turn, made it crucial to find alternative sources to the vulnerable rubber tree.

Natural rubber is present in more than 2,500 plant species, most of which are unsuitable for the large-scale production of high-quality rubber. Two plants other than the rubber tree show promise, however: The Russian dandelion and guayule, a South American shrub. EU-PEARLS (EU-based Production and Exploitation of Alternative Rubber and Latex Sources), a consortium of European companies and research organisations, is looking into how best to achieve a profitable and

sustainable production chain. Hans Mooibroek of Food & Biobased Research is coordinating the project.

## Promising results

In a promising development, the first tyres made from European natural rubber rolled off the production line in the factory of EU-PEARLS' partner Apollo Vredestein in July 2012. A prototype for hypoallergenic medical gloves has also been developed. 'In addition, the process delivers different by-products which

can serve as a basis for all kinds of chemicals,' Mooibroek explains. 'It is expected that further breeding can boost yields by 1,000 to 1,500 kg of rubber per hectare. In other words, the financial picture is also rather promising.' A major challenge still remaining is to extract the rubber and by-products efficiently and on a sufficiently large scale. Food & Biobased Research has taken on the task of developing the right facilities for this.

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# Establishing evidence for health claims

**While many food products are likely to have a beneficial effect on human health, the claims often lack solid scientific proof. Together with Wageningen UR's Division of Human Nutrition, we support companies in the food industry on various fronts with research into determining the effects of dietary components on health.**

## Good dietary fibres

An interesting example is the EU project FibeBiotics. This focuses on the development of tools to prove scientifically that certain types of dietary fibres are good for the immune system, and therefore healthy.

## Sustainable proteins

Where FibeBiotics focuses on fibres, the Customized Nutrition research programme studies proteins. Wageningen UR is working hard

on the development of alternative sustainable protein sources for both human and animal consumption. These sources include peas, quinoa, plant leaves, algae and insects. Customized Nutrition, with which a group of large companies in the food industry is affiliated, conducts research into the impact of these – often new – protein sources on the health of humans and animals. Practical applicability is an important part of the programme. Network SenTo examines

how people above 55 experience protein-rich foods. This is an important target group as a low protein intake appears to accelerate the aging process.

## Novel food

New products such as those rich in proteins, must meet strict safety laws before they can reach the market. This often requires them to be registered as a novel food first. To support businesses in this process, we are working on a decision tree together with industry partners in a public-private partnership. This allows manufacturers to enter available data on the product and subsequently see which additional information is still required for a product safety assessment.

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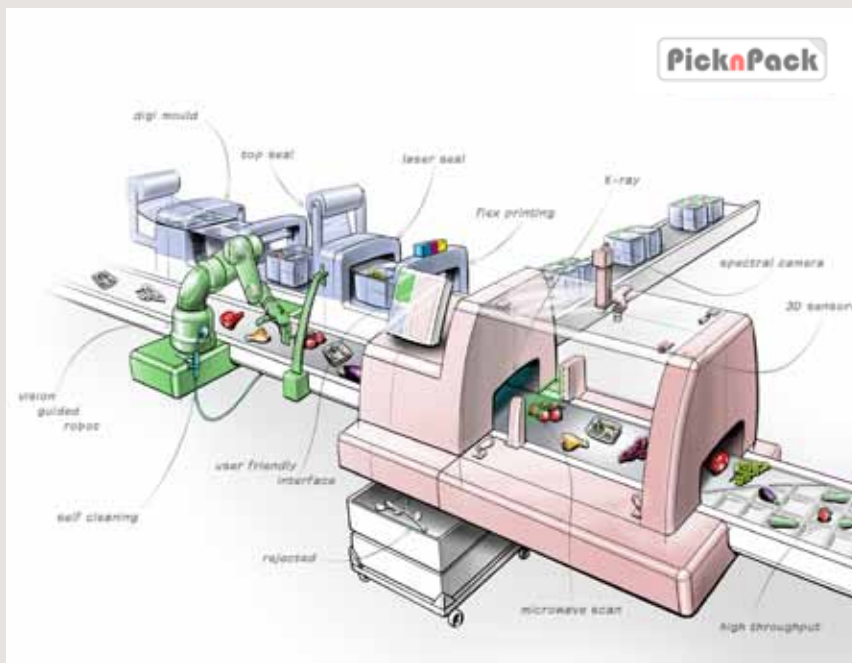
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# PicknPack

## A flexible robotic sorter and packer

Can robots act as flexible sorters and packers of food? In the European project PicknPack, 14 companies and knowledge institutes led by Wageningen UR are looking for the answer to this question. The aim is to develop a robot that can handle a wide range of products.



With PicknPack, the group aims to take a major step towards large-scale robotisation of the European food industry. Even today, there are many people working on conveyor belts to inspect, sort and pack fresh and processed foods. Unlike a robot, they cannot do this for 24 hours a day. Robots have the additional advantage of being able to work in low ambient temperatures, allowing the food to keep longer. The project is organised together with Greenhouse Horticulture, another part of Wageningen UR.

### Flexible robots

Existing robots in the food processing industry are often designed with one particular product in mind. This makes them inflexible: A large part of the production line needs to be converted in order to switch from processing tomatoes to mangoes, for example. PicknPack is expected to lead to a machine which can inspect, sort and pack various products.

In addition, the machine must be

able to handle several difficult-to-process ingredients simultaneously. A good example is ready-made meals with meat, vegetables and potatoes, which are automatically packed and sealed again after inspection. The packaging will also be designed and printed in a flexible way based on the measured properties of the product. These technologies will allow companies far more flexibility in responding to changing consumer demands, as they will be able to move to new product combinations quickly. And with one machine being suitable for multiple products, the solution will also interest smaller players in the market.

### Quality assessment

Food & Biobased Research has extensive knowledge and experience in the field of innovative technologies for automatic quality assessment, such as 3D sensors and hyperspectral imaging. For this automatic measuring process, scientists use existing knowledge on the quality aspects of products. The challenge is to design the robot so that it can verify quality at least as effectively as a person, with the added advantage that the automatic control is systematic and objective. Furthermore, a robot with different sensors can perceive more product characteristics than the human eye.

### Businesses

The companies participating in PicknPack include the British supermarket chain Marks & Spencer and Marel, the world's leading manufacturer of equipment for the food processing industry.

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# Breakthrough in sustainable chemistry

**Biomass as a raw material for the chemical industry? According to Jacco van Haveren, programme manager Biobased Chemicals, the definitive breakthrough is on its way. The technology is advanced and the industry is taking on the challenge.**

Biomass offers industry a viable alternative to petroleum says Jacco van Haveren. The programme manager has been developing biobased chemicals and materials based on vegetable crops for many years. These raw materials were mainly in the picture a couple of years ago in relation to the production of biofuels. However, major ethical and economic concerns were expressed around the world at the idea of producing fuel using crops originally intended for food production. Now the focus has shifted to

the use of biomass from non-edible waste products from crops.

## **Soda bottles and coffee cups**

The advancement of biomass as a chemical raw material has been progressing at a rapid pace over recent years. Food & Biobased Research, for example, has been working with several major players in the global chemical industry, with promising results. Van Haveren cites examples such as the production of basic chemicals like lactic acid,

isosorbide, succinic acid, adipic acid and furandicarboxylic acid. These chemicals, based on waste flows such as wheat straw and sugar beet pulp, serve as raw materials for products like plasticisers, nylons, textiles, soda bottles and disposable coffee cups. As well as serving as alternatives for products from fossil fuels, the products have another major benefit: They can replace potentially harmful chemicals. Van Haveren: 'Many baby feeding bottles contain bisphenol A, a toxic and supposedly carcinogenic substance. Building blocks based on biological waste products can be used as alternatives as long as they have the right thermal and other physical characteristics. We are increasingly successful in developing the chemical or biotechnological processes required to achieve this.'

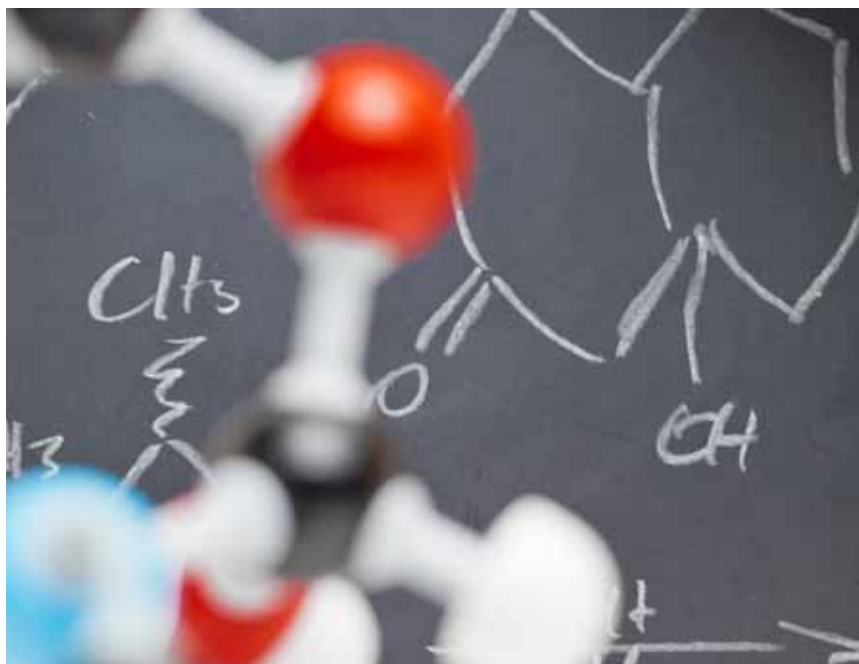
## **Lignin**

Scientists from Food & Biobased Research are also performing much research into lignin as a sustainable alternative for fossil raw materials. Lignin is a natural substance that gives trees, grass and straw their firmness and flexibility. It is released in the production of paper and cardboard, and is currently often incinerated to act as a low-value energy source. Lignin is also released when producing cellulose-ethanol from biomass. 'We are making excellent progress with lignin,' says Van Haveren. 'We have developed processes to improve the breakdown of lignin into chemical building blocks for industrial purposes. Together with our business partners, we are now taking the next steps required to market products such as coatings and adhesives as well as additives for asphalt.'

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# New tests allow rapid detection of micro-organisms

Food quality is influenced by many factors. For instance, some components give food its characteristic flavour. Other components may cause allergic reactions in humans, while certain micro-organisms can have both positive (in terms of taste) and negative (as pathogens/decay agents) effects. If there are harmful bacteria present in food, it is vital to detect them quickly. New tests developed by Food & Biobased Research provide fast answers.

An example of such a quick test is used to detect verotoxigenic *Escherichia coli* (VTEC), a sister of the EHEC bacterium that broke out in Germany in 2011. VTEC can have serious effects on human health, even leading to death in some cases. Scientists from Food & Biobased Research developed a rapid lateral flow test with five lines per test that takes just 15 minutes. The test, which is similar to a pregnancy test, provides information on the presence or absence of VTEC as well as on the various harmful proteins that this bacterium can produce by using carbon nanoparticles. The entire procedure, including the rapid multiplication of VTEC DNA, gives a result

within hours. Traditional tests need to be analysed in a laboratory, which means that a few days are required to get the result.

## Microarray

Another example of a test developed by Food & Biobased Research is the microarray test, which allows up to 20 different components to be quantified simultaneously in one sample with the aid of dozens of spots in a well from a so-called ELISA plate. An ELISA plate contains 96 wells, allowing scientists to measure many different samples in a single test. This test method can be fully automated and is therefore suitable for high-throughput screening.

## Malaria test

Within the framework of a European project, Food & Biobased Research developed a lateral flow test to help determine whether a person is carrying the malaria parasite. In this test a small amount of blood is subjected to a 30-minute DNA replication stage. If the parasite is present, it can then quickly be detected with the lateral flow test. Organised under the auspices of the project coordinator, the Royal Tropical Institute in Amsterdam, this test was evaluated in Thailand and found to be reliable, sensitive and specific.



The scientists at Food & Biobased Research have now combined the two test methods, leading to a microarray lateral flow test that can be equipped with 25 different spots, allowing up to 10 different components to be quantified within 15 minutes.

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# HyTIME: Producing biohydrogen faster

While hydrogen from biomass is a clean alternative to ever-scarcer fossil fuels, its production is a slow process. Nine European research institutes and companies within the HyTIME project are currently investigating ways to speed things up. The goal is to create a continuous fermentation process that could supply up to ten kilos of hydrogen a day. Food & Biobased Research leads this project.

The scientists working in HyTIME aim to optimise the process. Bacteria produce hydrogen from organic waste materials such as grass, straw and leftover vegetables and fruits. This takes place in oxygen-free conditions, and preferably at 70 degrees Celsius, when bacteria are most productive. Hydrogen can be

converted into electricity very efficiently and can, for instance, be used as fuel for vehicles.

## Local hydrogen factories

HyGear BV in Arnhem is one of the participants in the HyTIME project. It has been producing hydrogen for local factories for some time and has, among other things, developed the first public hydrogen filling station in the Netherlands. The company deliberately focuses on local, small-scale production as road transport is problematic with current technology: Hydrogen has a low density and to move large-scale volumes by road from a to b is bad for the environment. The European project HyTIME was launched on 1 January 2012 and will run for three years.

In addition to Food & Biobased Research and HyGear, seven other research institutes and companies are taking part: Heijmans Techniek & Mobiliteit BV, AWITE Bioenergie GmbH, RWTH Aachen University, Environment Park SPA, Vienna University of Technology, Wiedemann Polska Projekt and Veolia Environment Recherche & Innovation.

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## Vision on increasing international fresh food logistics

**As the global population grows, so too does the demand for food and food transportation. At the same time, sustainability is also high on the international agenda. This requires a thorough vision on the future of international fresh food logistics, and the Dutch Ministry of Economic Affairs has commissioned Food & Biobased Research to provide this. In the autumn of 2012, Joost Snels presented a joint vision on a Core Network Fresh Transport of international connections and multimodal hubs.**

The Netherlands has a leading position in Europe in the field of agro-logistics. To maintain this position, it is important that it takes the lead in the internationalisation of the agrofood sector and agro-logistics within a Core Network Fresh Transport that is not as much focused on networks themselves, but rather on the connections between those

networks. Snels imagines four to six hubs in Europe: 'This way the Core Network Fresh Transport can serve as a strong national and international foundation for major import and export flows that can be managed from clusters.'

## Modal shift

The hubs will preferably be

multimodal, both from a sustainability perspective and to facilitate growth. The European Union wants a European transport network in which a larger number of cargo flows are transported via the rail network and waterways. 'This requires a modal shift, in which the Core Network Fresh Transport can play an important part,' Snels explains.

The idea behind the Core Network Fresh Transport is in place. Now it is essential to integrate this idea into the thought process of policy makers. And then to get to work as the Netherlands again leverages on its prime agro-logistic position for this major organisational and facilitating task.

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# Flower transport by boat or train is better

## And not only for the environment

A significant proportion of flower and plant transport could be carried out more cost-effectively via boat or rail than by road. And emissions of greenhouse gases would quickly decrease too. These are the findings of a study by Food & Biobased Research and the Dutch Association of Wholesale Trade in Horticultural Products (VGB).

### GreenRail

The year 2008 saw the start of the GreenRail project, an initiative to transport horticultural products in a durable and cost-effective way by rail. The idea behind GreenRail is to slow down the chain for less time-critical products. The results have been very positive so far: GreenRail is reliable, cheap and durable. But what about quality? Food & Biobased Research accompanied pilot projects regarding transport of the 12 most common flowering plants and eight most common green plants from Italy and Romania. Temperature, relative humidity and ethylene values were measured throughout the journey, followed by extensive laboratory tests. The conclusion: There was no quality difference compared to road transport.

One in three trucks on the Dutch roads is transporting agricultural or horticultural products. Traffic congestion, rising fuel prices and sustainability issues are all good reasons to look closely at alternative transport options. But what about overall costs? It has been shown that, at distances of more than 800 kilometres – which represent some 44% of all transports in the horticultural sector – it is cheaper to forget the lorry and opt for the boat or train. At this distance, two drivers, not one, are needed to bring the cargo to its destination in a single trip. An additional advantage is the 60-75% reduction in greenhouse gas emissions when using the boat or train.

If the distance is even longer – imports of floricultural products from Africa and South America are currently rising, for example – then the boat is a worthwhile alternative to flying, reducing transport costs by 25 to 30% and decreasing CO<sub>2</sub> emissions by 80%.

### Compact and dry

Another way to keep both costs and CO<sub>2</sub> emissions down is by transporting flowers without water – without compromising on quality, of course. This can be done using boxes or crates, allowing many more flowers to be transported in a single load. The study 'Compact and Dry' showed that dry transport of roses can save up to 15% in costs. For tulips, savings amount to a whopping 47%. And handling and storage costs decrease proportionately as well.

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# Sustainable protein is the future

The global consumption of animal protein has grown substantially over recent years. As the worldwide ecosystem is not able to cope with further expansion, a transition to alternative protein sources will be essential to prevent future protein deficiencies. Wageningen UR is a leading research partner in this field.

Research into protein is one of the strategic spearheads for the coming years, and the multi-year Customised Nutrition programme combines all protein studies. The further development and testing of alternative protein sources in cooperation with the private sector is one of the components of the programme, says R&D manager Marchel Gorselink. 'We are linking existing chains. This allows us to see whether it is better to apply the protein currently mainly used for animal feed in new protein-rich products for human consumption.'

## Soy

According to scientist Marcel Minor, soy is a good example of a vegetable protein that can be used much

more efficiently. 'Most soy is currently used for animal feed; but every kilo in animal protein requires three kilos of vegetable protein in feed. We can increase efficiency partly by improving animal feed processes. It is something we are studying intensively, but we are also looking at alternative sources for animal feed. Insects, for example, are efficient protein sources. People in the West may not be overly keen, but chickens are not so fussy. This would enable us to shift a protein like soy into the human diet.'

Beeter, the new meat substitute that was marketed in cooperation with Food & Biobased Research in 2012, is a good example of a successful protein product in the 'new style'. A

benefit of soy is that the market is already familiar with it,' says Minor. 'But in the long term there will be a demand for new protein products, which is why we are carrying out a lot of research into algae and seaweed as promising protein sources. We are also studying waste products from the agro-food sector, such as beet greens, and from fish processing and bio-ethanol production.'

## Hybrid product

The market for human nutrition has already discovered alternative protein sources. 'Lean beef mince in the supermarket is a hybrid product, for instance. It consists of animal and vegetable protein,' Gorselink explains. 'And health care institu-

tions enrich clinical nutrition with vegetable protein to prevent protein deficiencies in the elderly. Large corporations understand that animal protein is becoming increasingly scarce and thus more expensive. They want to be part of the development of alternatives. We support these companies via the Customised Nutrition programme, as well as in bilateral research programmes.'

### Black box

Part of these research programmes is focused on the mechanisms behind new or reformulated products, says scientist Miriam Quataert. 'We take a look into the black box: What happens to the flavour and texture of a product when new ingredients are added or the composition is changed? With the resulting data, manufacturers

can make more specific adjustments to the product characteristics and shorten the time to market. Companies also want to know which preservation techniques will or won't work for their new or reformulated product. This is another area in which we can provide support. Promising technologies for the future are high pressure processing and pulsed electric field processing. These technologies have already made the shift from the laboratory to the market, partly thanks to Food & Biobased Research.'

### Consumers

As is the case with all new products, they are only successful when consumers buy them. But why do people buy some products and not others? Scientist Anke Janssen explains that Food & Biobased

Research has the knowledge and facilities to help provide companies with insight into consumer acceptance. This will help them market their products successfully. 'We perform classic sensory research among consumers and link it to physiological research into consumer emotions. We frequently study how consumers behave in real life as well; either in our own Restaurant of the Future, or in health care institutions and supermarkets. We are also very experienced in 'home tests', where people consume products in their own environment and evaluate them at their convenience. This combination makes us a very attractive research partner for the industry.'

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## Browsing through the biomass

A road made partly from the trimmings of nearby trees? It can be done: The lignin from these trees is a great base for bitumen, which is an important component of asphalt. For now, the necessary bitumen comes mainly from petroleum. Creating a biobased economy, however, involves switching from fossil fuels to green raw materials from sources such as biomass. Civil engineering and the management of waterways and natural areas result in large biomass flows that can be used in different ways, including in infrastructure.

The willows in the floodplain, the roadside grass along the highways – from a biobased perspective, the landscape harbours a wealth of biomass. In this context, carting off trimmings does not cost money, but rather adds value by providing green materials. Food & Biobased Research estimates the quantities of biomass that can be profitably used for Rijkswaterstaat, part of the Dutch Ministry of Infrastructure and the Environment. 'If a profitable logistics chain can be developed, Rijkswaterstaat can earn

money with home-grown biomass in the future,' says business development manager Brenda Israel. 'And we may even be able to create biobased components for infrastructure.'

### Biobased infrastructure

Asphalt, geotextiles, artworks, architectural concrete and street furnishings – the petrochemical additives they contain can all be replaced by biobased ingredients. According to Brenda Israel, there are plenty of opportunities for a

biobased infrastructure. 'The first question, of course, is: What is possible? There is still much to discover, test and translate into large-scale, cost-effective production and economically viable materials. This is done in research projects into green resources, together with the private sector, other research institutes and the government. But there are already profitable biobased alternatives, as well as a corresponding demand.'

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# Aiming to reduce food waste by half

In the Netherlands alone, several billion euros worth of food is thrown in the bin or used for unnecessarily low-grade purposes every year. Solutions for reducing waste are within easy reach and reductions of between 40 and 50 percent are possible.

Consumers are the main culprits. On average, people buy 20 percent too much food and cook 30 percent too much for the evening meal. Ten to 17 percent eventually ends up in the bin. It is a major challenge

## FUSIONS

Research and innovation will provide a major contribution to slashing food waste in half by 2025. This is the ambition of FUSIONS, a European consortium of 21 universities, organisations and businesses, coordinated by Wageningen UR Food & Biobased Research. By innovation we mean clear labelling of the expiry date on a product or social innovations that lead to creative solutions in society. FUSIONS begins with clear definitions and a common methodology to assess the magnitude of the problem.

but Toine Timmermans, programme manager of Sustainable Food Chains, is convinced that the wasteful behaviour of consumers can be changed. 'Imagine products that keep for longer thanks to mild preservation techniques, or portions for one-person households. We can also provide better information on the actual shelf life of products to give consumers a push in the right direction.'

It is helpful if consumers realise just how much food gets wasted. This is why Food & Biobased Research organised the Food Battle programme with waste management companies Circulus and Berkel Milieu in the autumn of 2012. People were given tips to help them waste less food at home.

The first results showed that the Food Battle raised awareness: For instance, products were more likely to be kept in the appropriate place (e.g., meat in the lower part of the fridge where it's cooler), and people also adjusted their purchasing behaviour.

## Saving money

It is ultimately possible to reduce waste by 40 to 50 percent, with companies and institutions paying increasing attention to the problem. This makes sense as food security and rising commodity prices are topical issues. A practical example is a new meal concept deployed by healthcare institutions to save tens of thousands of euros a month: Patients now get their food served directly on the spot and do not need to choose their meal days in advance. Between 36 and 48 percent of the food used to be thrown away, while the new concept reduced this to a mere 2.2 percent.

## Model

The concept is being introduced at several other institutions. In the TI Food & Nutrition project called Reduce Spoilage, scientific knowledge and a decision-supporting model were developed to support companies in implementing the most promising measures for improvement and innovation. The focus is on fresh products, such as vegetables, bread and meat. The project was designed in partnership with the Dutch food industry and supermarkets. Such close cooperation within the chain is crucial for the realisation of radical improvements.

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# Dutch regions embrace the biobased economy

Regional initiatives for the development of green business are starting up throughout the country. Food & Biobased Research plays an important role in many of these initiatives.

According to business development manager Brenda Israel, Food & Biobased Research is increasingly cooperating with companies and regional authorities in setting up biobased value chains. 'We offer regional partners technological knowledge and expertise in the development of biobased products for a variety of applications,' Israel explains. 'But we are also experts in socio-economic and sustainability aspects. These aspects often come together in our projects.'

## Biobased Delta

Israel is involved in the developments within the Biobased Delta, a biobased partnership between the private sector, local authorities and the research community in the south-western Netherlands (Zeeland and West-Brabant). The participating authorities and companies signed an agreement at the end of 2012 which soon led to a number of tangible projects within the top sector Agri & Food. One example is a project to develop small-scale biorefinery concepts and demos. 'A significant benefit is that a pre-separation takes place at the location where the biomass becomes available – the useful components, such as sugars, proteins and fibres, can be separated from the water and nutrient fraction,' Israel says. 'The valuable components are subsequently processed in the factory, and the nutrients can be returned to the land in the form of fertilisers.'

## Biodegradable flower pot

The province of Gelderland is one of the Dutch regions with major ambitions in the biobased economy. 'There's a lot happening in Gelderland,' explains Gulden Yilmaz, programme manager biorefinery at Food & Biobased Research. One example is the Biobest

subsidy program, which had focused on the development of biobased products. Many of the products developed with the support of this subsidy program have made it to the market, such as the biobased flower pots. The advantage of these flower pots is that they are completely biodegradable in soil. Removing the pots from the plants is no longer necessary, avoiding damage to the roots.'



## Biobased de-icing salt

Scientists from Food & Biobased Research are also working on a project in Gelderland to achieve a sustainable alternative to de-icing salt. The project is called TOPAAS, and it focuses on converting roadside grass and kitchen waste, to an organic salt and hydrogen, using bacteria. This salt is less toxic and corrosive than regular de-icing salt, making it the preferred solution to prevent slippery conditions in winter.

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# Mild preservation techniques

## Extend storage life while retaining flavour and health benefits

Try to imagine 21-day-old orange juice that is just as healthy and tasty as on the day it was squeezed. This is just one example of a product that can now be kept for longer with no discernible loss of quality, thanks to new mild preservation techniques. Wageningen UR Food & Biobased Research has joined forces with the business sector to examine these promising techniques.

High pressure processing is one of the techniques that have already found their way onto the market. This is an alternative method for preserving products that are traditionally pasteurised or sterilised, such as cold meats, fruit juices & drinks, and ready-made meals. The new technique neutralises micro-organisms by exposing them to a pressure of up to a thousand MPa. According to Ariette Matser, scientist at Wageningen UR Food & Biobased Research, high pressure processing is a fairly established method for preserving refrigerated products. 'I would estimate that around two hundred food products on the European market are already being preserved using this high pressure method.'

### Pulsed electric fields

Another technique currently making its way from the lab to market implementation is pulsed electric field-processing. This technique makes short work of micro-organisms in liquid products such as fruit juice, milk, yoghurt and soup by subjecting them to high voltage currents while they are pulsed at a low temperature. Wageningen UR Food & Biobased Research and

Hoogesteeger, which leads the fresh fruit juices and smoothies market, joined up to develop the Fresh Micro Pulse, a technique that was nominated for the Food Valley Award earlier this year. It keeps fruit juice 'fresh' for 21 days without compromising its quality. There is a lot of interest in this technique, says Marjolein van der Glas, business development manager at Wageningen UR. 'But it still needs a bit of work before producers can order tailor-made production lines operating this technique.'

### Cold plasma

The cold plasma technique has even further to go before it reaches the production stage. This method uses cold gases to disinfect the surfaces of packaging or food products, and is attracting a lot of attention from the food industry. Hardly a surprise, says Ariette Matser. 'There are very few options for cleaning surfaces of this kind. Many of them are not heat-resistant, cleaning with water is expensive and chemicals are often out of the question. But gas reaches every nook and cranny.'

### Volumetric heating

A fourth technique currently being

tried out in pilots is volumetric heating. This technique could provide a method for defrosting large quantities of food swiftly and evenly, as well as for pasteurising or sterilising certain products. It uses microwaves or radio frequencies.' The main advantage of this technique is that it is based on a very familiar mechanism: heat kills micro-organisms,' explains Ariette Matser. 'But you have to be sure that the food is heated right through. There are numerous technical solutions to this problem, and we are currently looking into them.'

### What works and what doesn't?

A previous EU study laid the foundations for further scientific research, some of which is being conducted in the Dutch government's Agri&Food top sector. Continued research is needed to pinpoint the exact factors that affect the final results of preservation techniques. 'Companies obviously want to know what works for their product and what doesn't,' says Marjolein van der Glas. 'We can help them to answer this question during PPS programmes, as well as in private projects commissioned by a specific client.'

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# Microalgae: Green gold

## Now to turn a profit

Microalgae research is in full swing at Wageningen UR. The AlgaePARC (Algae Production And Research Centre) is up and running, and Food & Biobased Research now uses it for comprehensive, integrated and multidisciplinary research. The research centre will play a key role within Europe in the optimisation of algae cultivation. Meanwhile, there are various research projects already underway or about to be launched which will help make the most of algae.

Microalgae (or phytoplankton) can play a vital role in a sustainable biobased economy: As environmen-

tally friendly producers of commodities such as oil, protein, starch and pigment for diverse products, from



biofuel and plastics to colouring agents and foods; and also as recyclers, as algae survive well on waste streams such as carbon dioxide, residual water and diluted manure, with cleaner water as a bonus.

### Profitability

Algae can also be efficiently and sustainably grown in places where agriculture is impossible and where no negative impact on the environment would be felt. Achieving profitability is another story: It would require production efficiency to be increased by a factor of three and costs to be reduced by a factor of ten. To work towards this goal, the research programme will compare the four major algae production systems, and investigate, via manipulation the best conditions and more efficient, cheaper and more sustainable cultivation processes.

During 2012 the programme reached an important next step: The 'AlgaePARC Biorefinery.' The aim is to be able to extract all components – oil as well as proteins and carbohydrates – from the entire biomass of algae in a way that is as technologically efficient as possible.

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### New algal project: SPLASH

November 2012 marked the start of the Sustainable Polymers from Algae Sugars and Hydrocarbons (SPLASH) project. This involves 20 partners from research institutes and private sector in making plastic from microalgae. The main protagonist is the alga *Botryococcus*, that creates long carbon chains and sugars which allow good-quality plastic to be

made. There is just one disadvantage: *Botryococcus* grows very slowly. That is why SPLASH aims to build the *Botryococcus* genes that produce long carbon chains and sugars into faster-growing algae.

The next step will be to 'milk' the algae, extracting the useful substance without killing the plants.

Currently, algae have to be killed to be harvested in a cumbersome process that involves many steps. While it has not yet been possible to find a way to milk algae successfully, the technological knowledge is evolving. The scientists are hoping that a new machine will allow them to extract carbon chains and sugars from living algal cells.

# Interactive storage system that 'listens' to apples

**People expect to eat apples of a consistently high quality throughout the year. With this in mind, the fruit is stored in a controlled atmosphere, with a carefully monitored temperature, oxygen and carbon dioxide levels and humidity. The system takes very little account of biological product differences, however. The new Dynamic Control System (DCS) offers a solution.**

DCS 'listens' to the product. If the oxygen level in the apple cooling cell (Controlled Atmosphere room) falls below 1% this leads to the release of alcohol, which indicates that the apple is about to start fermenting. DCS measures this alcohol concentration and regulates the oxygen levels accordingly. This ensures the apples are kept in the best possible atmosphere. Food & Biobased Research has proven that DCS keeps apples tasting juicy

and firm as well as maintaining an attractive appearance. Moreover, chemical preservation methods are no longer required as physiological issues such as scald are prevented by DCS.

## Patented

Scientists at Food & Biobased Research have succeeded in fully automating the DCS process, which has been patented since 1998 and recently received its own trademark



(DCSTM). This makes the system of commercial interest and Storex, a company that supplies controlled atmosphere installations, is partnering with Food & Biobased Research on further development. The essential alcohol sensor is being developed by EMS. The expectation is that the sector will switch over to DCS in the coming years as the storage method for apples, pears and other sorts of fruits and vegetables.

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# Small creatures produce chemical building blocks

Micro-organisms are ideal for converting sugars from agricultural crops into chemical building blocks for products such as polymers or fuels. These processes are studied in industrial biotechnology. Together with the industry, Food & Biobased Research is working hard to develop new techniques.

In industrial biotechnology, bacteria, fungi and other micro-organisms are responsible for the conversion process from raw material to chemical compound. The small creatures are used to convert sugar cane into lactic acid, itaconic acid and fumaric acid for instance, which is then used to

produce bioplastics. Depending on the desired chemical building blocks, scientists determine which micro-organism is the most likely to survive in certain conditions. They also adapt the micro-organism to ensure the conversion into chemical building blocks occurs as efficiently as possible.

## BE-Basic

The industry has a major demand for sustainable alternatives for traditional petroleum-based processes. This is illustrated by BE-Basic, an international consortium in which a large number of companies, knowledge & research institutes and

governments have joined forces to develop new bioprocesses. BE-Basic has a budget of 120 million euros, half of which is financed by the Dutch government, while the private sector and knowledge institutes contribute a quarter of the total amount each.

## Bilateral projects

BE-Basic is a good example of a successful public-private partnership (PPP) programme. Food & Biobased Research also works in bilateral projects with companies to develop innovative biotechnological processes. An example is the collaboration with the French oil company Total, which has been ongoing for many years.

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# Tasty food

## improves quality of life for the elderly

As children we were told that good food would make us big and strong. The latter benefit applies to grownups, too – elderly people who eat healthy and sufficient food continue to live independently for longer and require less care. And if they do fall ill, they recover much faster. 'Voeding en ouderen' ('Nutrition and the elderly') is a programme consisting of seven projects put together by Food & Biobased Research in cooperation with various partners. It examines the role of nutrition and the meal experience in healthy ageing, and helps develop food products and services that can make a positive contribution.

One in ten senior citizens who live at home is malnourished. In nursing homes, the number rises to 20% - and in hospitals to 25%. A serious problem with serious consequences, including slower recovery from illness and surgery and an increased risk of complications. This can lead to a negative health spiral with longer hospital stays, increased use of medications and more complex care. 'Voeding en ouderen' aims to improve the health and wellbeing of elderly people through their food consumption. There is a great deal to be gained in physical and economic terms, and above all in quality of life.

### Enjoy your dinner

This programme intends to find out whether newly developed products, meal concepts and adapted ambience are indeed effective. Ambiance has already proven to be important in the study 'Genieten aan tafel' (enjoyment at the table) which looked at the role of the meal experience in nursing homes. During a trial, residents ate in a 'cosy' restaurant-like setting. In this ambience they stayed longer to socialise after meals and did not end up losing weight, which is what usually happens to people in nursing homes (as was also true for the control group in this pilot study).

### Cater with Care

This joint project between Wageningen University, Gelderse Vallei Hospital, Carezzo, Heinz, Pure4You, Sodexo, Stichting Promotie Kalfsvlees and NIZO food research was started in 2012 to develop and test high-quality, enriched and tasty foods. The relevant foods all fit into a normal diet, in order for health gains to be achieved in a relatively simple way. This results in a varied offer of products and services which can improve the health of the elderly and patients.

### SenTo

SenTo, the consumer panel of the future, comprises some 800 people aged 55 and up, who live at home. There is no such thing as a single, all-encompassing profile of the senior citizen, and this panel allows segmentation by, for instance, age or smell and taste sensations. The panel contributes to research into the valuation of new products, meals and meal components.

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# A hub in the top sector policy

The Netherlands implemented its so-called top sector policy in 2011. This initiative by the Dutch government is designed to stimulate innovation in sectors that are crucial to the economy. Government, companies and research centres form a 'golden triangle' in 'top consortiums for knowledge and innovation' (TKIs) within the designated sectors. These TKIs are a breeding ground for the joint development of new knowledge and expertise, which is crucial to all stakeholders.

'Thanks to the top sector policy, the private sector has more influence on the research agenda in the Netherlands,' says Charon Zondervan, programme leader of Food & Biobased Research. A year after the implementation of the top sector policy, he finds that the agendas of the Agri-food, and Horticulture and Breeding sectors are now in line with the strategic plans of the University. 'The projects

which we believe to be of strategic importance to the Netherlands have all been accepted by the Ministry of Economic Affairs.'

### **Sticking to old habits**

'The top sector policy has not caused our knowledge institute to work differently,' adds Erik van Seventer, manager of the Biobased Products business unit. 'We have always been accustomed to working

with the industry in public-private research programmes or bilateral projects. The top sector policy fits our culture and the way in which we are used to dealing with clients.'

### **Lowering the threshold**

The government implemented the top sector policy in order to lower the threshold for companies to invest in research and development. And Zondervan feels that

the gauntlet has been taken up. 'It has created a lot of traffic: We are often contacted by companies who wish to exchange ideas with us about possible joint projects. We had never before been in contact with a lot of these companies, as they had little or no experience with longterm R&D projects. We now actually work together with many of them in TKIs.'

As an example, Zondervan cites ATAG, a manufacturer of kitchen appliances. 'This company was looking to set up a project called 'eating is experiencing' to enable people in care homes to cook for themselves. It was accepted by the Ministry, which was great for ATAG as it can plan for the longer-term together with the other parties in the consortium. And it was good for us as ATAG contributes expertise that we otherwise would not have.'

### Small-scale biorefinery

Van Seventer points out that the research agenda for the biobased economy is formulated in close cooperation with Food & Biobased Research and the stakeholders in the top sectors. 'In the small-scale biorefinery programme, for example, we are leading the way as a knowledge and research institution. If you can bring the first biorefinery stages closer to the land, crops which otherwise quickly rot after harvest can be directly converted into sustainable intermediate products. This is very interesting in the long run as it allows peaks in manufacturing to be evened out. It can also bring additional income to farmers who take over part of the biorefinery process. In other words, there are many opportunities and it is not surprising that scores of small and large companies have joined the project.'



### Core of the expertise domain

Two of the nine top sectors; Agri-food, and Horticulture and Plant Breeding, are at the core of Wageningen UR's domains of expertise. Wageningen UR is the most visible partner in these sectors. This is also true for programmes in the overarching Biobased Economy theme. 'As Food & Biobased Research, we are uniquely positioned to connect 'food' and 'biobased', Van Seventer underlines. 'The project with small-scale biorefinery is a good example of this. Another case in point is the Bioeconomy Innovation Cluster, which was set up in the eastern Netherlands to bring together regional biobased economy businesses.'

These are projects in which Food & Biobased Research is at its strongest. We excel at working with the private sector on new technologies for innovative processes and products. Our door is always open to companies who wish to engage in a conversation or partnership.

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*'Thanks to the top sector policy, the private sector has more influence on the research agenda in the Netherlands'*

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# At the centre of the biobased economy

Changing from fossil-based materials to green, renewable biobased ones will ensure that more food, energy and raw materials are available for everyone.

The biobased economy is an important step in the transition to a more sustainable society. Food & Biobased Research is at the centre of this development, with research and education initiatives that cover the entire chain. Scientists are working on the development of knowledge, applications and solutions together with government, industry and other research institutes.

They provide the knowledge and skills which allow the

private sector to process biomass and green building blocks into different (intermediate) products, from energy and transport fuels to materials such as plastic, chemicals and medicines. Knowledge and skills are passed on to students at Wageningen University and several higher vocational education (hbo) programmes in which we support teachers and give lectures. Food & Biobased Research also publishes the Green Raw Materials (Groene Grondstoffen) series. These booklets provide accessible information on various biobased topics to policymakers and others who are interested.

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## Groene Grondstoffen publications

Three publications were published in the Groene Grondstoffen series in 2012 – the 14th, 15th and 16th:

Biocomposites 2012 describes the current status and opportunities of natural fibres and bioresins as basis for green composites. While 100% biocomposite is still a long way off, once it is achieved we will have a great ultra-light, super-tough and low-maintenance material for automotive, aerospace and construction industries.

The biobased construction materials catalogue gives an overview of all construction materials available in the Netherlands. It highlights the variety of available biobased components, materials, products and services.

This is illustrated by examples of sustainable projects in the Netherlands.

Green building blocks for biobased plastics describes the processes of various biobased chemical building blocks for plastics, from development to commercial production. From a chemical perspective, nearly all building blocks for plastic can be made from renewable raw materials. The key question is: Which processes are commercially feasible?

For other publications and further information visit [www.groenegrondstoffen.nl](http://www.groenegrondstoffen.nl).



# CATT shown to be effective against mites and nematodes

Strawberry plants are very sensitive to plant diseases. For a few years now, breeding companies have been successfully using Controlled Atmosphere Temperature Treatment (CATT) against the strawberry mite as an alternative to the now banned methyl bromide. In a modified form, this non-chemical method also appears to be highly effective in the elimination of parasitic nematodes.

CATT was commissioned by the breeding sector and developed by two institutes of Wageningen UR: Food & Biobased Research and the Applied Plant Research Lelystad. This method involves the treatment of plant material under special air conditions and a higher temperature in a gas tight cell for two days. CATT has been applied to eliminate strawberry mites in infected plants for several years at two different specialised companies in the Netherlands: Ruvoma in Montfoort and Van Acht Koel- en Vriesopslag in Sint-Oedenrode. The method was also already known to attack the root-lesion nematode *Pratylenchus penetrans* and the root-knot nematode *Meloidogyne*

hapla. However, the CATT method developed against the strawberry mite did not turn out to be effective enough to suppress these tiny pests completely.

## Modified CATT

Further studies on behalf of the breeding sector examined whether an adapted form of the CATT system might also effectively combat both the mite and the two types of nematodes. Various types of strawberry plants were treated under a specialised CATT method for this purpose. The study yielded excellent results: The strawberry mite was completely suppressed, while more than 99% of the *Meloidogyne* hapla was eliminated. At 90%, the elimination percentage for *Pratylenchus penetrans* was slightly lower. After treatment, all the plants were found to be vital enough for further growth. This method has been applied in practice from the end of 2012.

## Promising results

Scientists from Food & Biobased Research have since carried out other tests with CATT together with colleagues from various parts of Wageningen UR against other plant diseases and on other plant products. The results were very promising: The CATT method seems to be the solution of the future when it comes to the control of many plant diseases – although it needs to be kept in mind that every plant and every pest has its specific sensitivities. Solid research is required to find the right CATT solution for each individual situation.



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# Biobased impulse

## for higher vocational education (hbo)

Developments in bio-synthetics and plastics are occurring at a rapid pace, and with equally fast results. Within a short time, biobased materials have become widely accepted as a fully-fledged alternative to petroleum-based products. We see them everywhere; in cars, aircraft, computers, appliances and at institutions for higher vocational education (hbo), where teachers and students alike are keen to learn more about biobased materials.

Together with the DPI Value Centre, Food & Biobased Research developed the Train the Teacher course. 'With this course we fulfil a major demand from the eight hbo institutions participating in the project,' says Ben van den Broek, one of the scientists working on the 'biobased impulse' for higher vocational education. 'Chemistry, chemical technology and engineering

teachers in particular are eager to know more about biobased materials; from the building blocks to the production of new, green synthetics. It will provide them with a link to the industry and practice, while allowing us to reach a larger number of students as well.'

### Towards a green future

And this is of course the ultimate goal: To prepare students for a green, biobased future. 'We also organise tours at Food & Biobased Research to introduce them to our work with biobased materials in practice,' Van den Broek continues. 'In addition, we host lectures, and help set up education modules such as laboratory classes. The green future is in their hands, after all.'

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### Biobased Performance Materials (BPM)

Within the Biobased Performance Materials programme, knowledge institutes and businesses work together to develop new bio-polymers (that serve as raw materials for bio-synthetics) and perform applied research to improve the characteristics of existing bio-synthetics. The programme is coordinated by Food & Biobased Research. For more information see [www.biobasedperformance-materials.nl](http://www.biobasedperformance-materials.nl).

## Intelligent systems analyse a wide range of data

The IT scientists at Food & Biobased Research work tirelessly to develop intelligent systems that can combine and analyse many types of data and deduce the desired information. The technologies developed form the basis for applications which enable complex data analyses, but can also be used for systems that study individual products.

### Match X

A good example of the latter is the Match X software, developed by the Intelligent Systems group in cooperation with the Swedish company ITAB Scanflow. Among other things, the software forms the basis of the Easy Flow system, a rapid self-scanning checkout that identifies 35,000 products without using their barcodes. While common self-scanning systems do use barcodes, they are often far from

infallible. It is, for instance, an easy feat to place the barcode of a cheap product on a more expensive one.

### Digital fingerprint

The Easy Flow resolves the reliability system of existing self-scanning systems by analysing a wide range of data obtained by means of colour cameras, weight sensors and spectrometers. Using advanced statistical methods the system determines the digital fingerprint of each product. It identifies no less than 99 percent of the scanned products correctly. What makes the Match X system even more special is that it is a self-learning system: The more it is used, the more accurate the measurements become.

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# E-science in food research

Imagine how fabulous it would be to use software that thinks along with you, allowing you to find without any effort exactly the research information you are looking for. IT scientists at Food & Biobased Research are working on intelligent systems that are making this a reality in the food industry.

Tiffany is the name of a new web application at TI Food & Nutrition (TIFN, a public private partnership of science, industry and government conducting strategic research in food and nutrition). Tiffany aims to make research more transparent to the TIFN scientists. 'Until the advent of computers, all information regarding a research study was written down on paper in the laboratory journal,' project leader Jan Top explains. 'This was the main document for the study. Nowadays however, a lot of research information is dispersed in many different places. Tiffany allows us to return to the cohesion we used to enjoy. Using the application, scientists store all pieces of relevant information as a network interconnected by hyperlinks.'

The request to staff members at TIFN is to describe data in simple terms. 'We have developed an approach within Wageningen UR's e-Foodlab project which enables scientists to combine and compare data from various sources,' Top continues. 'We have also set up a

semantic search engine to allow the scientists to search for related information on the Internet. This creates a large database within which information can be linked far more easily than before.'

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*'Information can be linked  
far more easily than before'*

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More focused searching is also the aim of a new text analysis tool being developed by Food & Biobased Research in collaboration with VU University Amsterdam, Radboud University and the NIZO institute for food research. The aim of this project is to develop a vocabulary with which existing studies in the field of nutrition can be labelled and results can be combined. 'This would allow you to find indications of an association between a gene expression and a plant disease, for instance,' Top explains. 'And this in turn would lead to much more focused follow-up research as possible connec-

tions have already been found.'

Professionals in other areas are also looking for similar solutions. Commissioned by Syntens and the Dutch Chamber of Commerce, Food

& Biobased Research has developed the application sCore. It provides support to Syntens' innovation consultants, who in turn help businesses find the right knowledge to innovate. 'With sCore, we help the innovation advisors look for appropriate information in recent sources based on the company's search profile,' Top concludes. 'This makes their search more focused as certain search terms are associated with concepts specific to the relevant company.'

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To explore  
the potential  
of nature to  
improve the  
quality of life



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Wageningen UR Food & Biobased Research is part of Wageningen UR (University & Research centre).

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Wageningen UR Food & Biobased Research is the R&D organisation for sustainable innovation in the areas of healthy food, sustainable fresh food chains and biobased products. National and international industries and partners choose Food & Biobased Research because it is professional, provides innovative market-oriented solutions and has a high scientific standing. Wageningen UR Food & Biobased Research works closely together with customers and partners to develop creative solutions to gear up for sustainable and profitable growth.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.

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