



# Food & Biobased Research

**Topics 2012**

*Smart agri-food chains*

**Bulk chemicals from biomass**

Bioplastics

Mild processing technology



FOOD & BIOBASED RESEARCH  
WAGENINGEN UR

# INTRODUCTION

Albert Einstein once said, "I never think about the future. It comes soon enough." And although the march of progress does seem inevitable, it doesn't mean we can take it for granted. At Wageningen UR Food & Biobased Research, we not only think about the future, we are actively involved in shaping it. We develop many innovations for food and biobased chemicals, -materials and bioenergy that are key to unlocking the future. We do so because mankind faces numerous pressing challenges on several fronts. Many of these challenges relate to sustainability issues brought about by the world's ever-increasing population, diminishing resources and rising energy requirements. But there are also major opportunities for environment, health food and nutritional needs. For this, we and many others are working busily on solutions. We do this in close collaboration with industrial partners, governments and other knowledge institutes. And we do it to ensure that tomorrow's world is brighter for everyone. Welcome to this glimpse into the future.

**Raoul Bino**  
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The world is reaching its boundaries. Stocks of fossil fuels, ores and phosphates are slowly becoming exhausted. There is a growing awareness that we need to move towards a sustainable economy. But how? In 2004 Wageningen UR Food and Biobased Research went to the then Ministry of Agriculture, Nature Management and Fisheries not with a densely-written policy paper but with a clear PowerPoint presentation on the Biobased Economy. The presentation put the message across convincingly. Within four months the then Minister Cees Veerman had set up the Biobased Economy task-force.

## Wageningen UR Food & Biobased Research

# Added value for sustainability and health

Wageningen UR was at the basis of the transition to a sustainable economy and is now at its epicentre. "We were an innovative pioneer, and will always remain so", says Erik van Seventer, Manager of the Business Unit Biobased Products. Together with 'Fresh, Food & Chains' his business unit forms the contract research institute Food & Biobased Research, a division of Wageningen UR. The underlying concept of the bio-based economy is that crops should be used as effectively as possible. Priority number one is food production. It

is also possible to make materials and chemicals from plant constituents following biorefinery. What remains after that can be used for the production of biofuels and bio-energy.

"At Fresh, Food & Chains we work on sustainable food chains, healthy food and consumer food choice behaviour", explains Business Unit Manager Annemieke Beers. "We develop storage technology and fresh product logistics, more sustainable processing and healthy products: everything that makes food healthier

and more sustainable. Through our major programmes in the areas of sustainability, processing and consumer behaviour we help our clients to produce more sustainably and to realise innovation."

Applied research has already led to notable results in both Biobased Products and Fresh Food & Chains. Some examples are given in this magazine. They were achieved in close association with industrial and other clients.

"As evidenced from recent client reviews, our clients rate us highly for our result-driven, multidisciplinary and innovative approach and our high level of knowledge. Food and Biobased Research is among Europe's leading research institutes in this area. We intend to build on this position with our partners and for our clients through excellence and cooperation", is how Erik van Seventer expresses the ambitions.

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Annemieke Beers & Erik van Seventer  
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# Turning *oil-palm* waste into *valuable products*

An innovative biorefinery concept for the isolation of components from a palm-oil industry waste stream, i.e. empty fruit bunches, will result in valuable materials that can be converted into products with an even higher market value. The most valuable component is the cellulose fraction which can be isolated as a cellulose pulp. Besides being used for paper and board, this pulp can also be purified into dissolving cellulose pulp for the production of cellulose derivatives as found, for example, in the clothing industry and biobased plastics.



### From 'nuisance' to valuable commodity

The oil palm produces fresh fruit bunches which are full of oil-containing fruits. After removal of these oil fruits the fresh fruit bunches are called empty fruit bunches (EFB). In Indonesia and Malaysia approximately 40 million tons of EFB are generated each year, but applications are limited because of the low calorific value, making it unsuitable for heat and power generation. Storage is also not easy and it is too bulky for transportation, resulting in large amounts of EFB being returned to plantations, partly for use as fertilizer. This cheap and abundantly available

raw material is, however, very suitable as feed-stock for the production of valuable products.

### Higher profits, smaller footprint

Financed by Biority B.V. and subsidized by the Dutch government, Food & Biobased Research started the GREENPALM project with a feasibility study for selection of an environmentally sound EFB pulping process. Key parameters were the efficiency of fractionation (e.g. quality of cellulose, hemicellulose and lignin fractions) and the ability to operate on a scale comparable to a palm-oil mill. From this study it was concluded that organosolv pulping was the most suitable option. The second phase was focused on the development of lab scale processes and technoeconomical evaluation. In this phase, proof of concept was demonstrated and the biorefinery concept was filed for patent application.

"For dissolving cellulose pulp you need to isolate the cellulose with a high degree of polymerization and purity," says Paulien Harmsen of Food & Biobased Research.

"Normally this is done by using cotton or wood, materials that contain a lot of cellulose. We worked with EFB, a recalcitrant lignocellulosic material, which besides cellulose

also contains hemicellulose, lignin and oil. By fine-tuning the pulping process we succeeded in isolating the cellulose and also the other valuable fractions."

Based on this, pilot-scale production of high-grade cellulose pulp from EFB in Malaysia was initiated and is still in progress. Dissolving cellulose pulp from empty fruit bunches means higher profitability through the production of high-value products from low-value biomass, while improving the environmental footprint of a palm oil mill.

"The fact that biomass and in particular EFB from palm oil is worth investigating was pointed out to us by Food & Biobased Research as early as 2006," says Floris Berkhout of Biority B.V. "We were early adopters of the research and have since presented the biorefinery concept to palm mill owners with promising reactions. We expect to be able to upscale the concept to an economically viable factory that will be used throughout the industry and together with FBR we plan to use the same concept with other biomass."

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# *A valuable partner for preventing food waste*

Wageningen UR Food & Biobased Research has been engaged in many projects to explore & reduce the extent of food wastage together with partners in the food supply chain. In the Netherlands alone, it amounts to 40 kg per person per year in household situations. On top of that the amount that is wasted by Dutch companies and in monetary terms the figure runs into billions.

## **Legislation is an obstacle to reduce waste**

"Companies experience that food laws and regulations cause waste throughout the food chain," says Toine Timmermans, programme manager Sustainable Food Chains. "We investigate which obstacles companies perceive to have an effect on food wastage in the chain and analyze the laws and other factors to find out how and why. Some waste streams are often inefficiently disposed of despite having potential for human consumption."

Making knowledge available to the relevant stakeholders, looking at improved measures, e.g. in improved

use-by-dates, are ways in which we are helping to reduce food waste."

## **Science behind waste**

Other ways include working together with organizations such as Top Institute Food (TIFN) with which Wageningen UR has just started a research project on how to reduce spoilage of fresh and chilled food products, such as meat, bread and vegetables.

The objective of the project is to develop a decision support system that will be used by retailers and food processing companies as a toolbox to analyze their supply chain of perishable food products and to

evaluate the effects of logistical and technological innovations on the potential spoilage reduction.

## **Households targeted**

Dutch households throw away a large amount of food with their normal rubbish, even before it has reached its use-by date. So, when BerkelMilieu, a Dutch refuse-collection company, set itself the goal of reducing the level of food waste from 50 to 10 kg per person, per year, by 2030, Wageningen UR researchers, together with a multi-stakeholder expert group, designed a number of intervention strategies for how householders could be per-

suaded to throw away less food. The most promising intervention strategies will be carried out in 2012, including one that encourages collaboration between civilians and local super-markets.

## **Hospital project**

A recent project at the Dutch hospital, Maxima Medical Centre, has already shown that not only can food wastage be reduced and money saved, but that it can be done with positive effects on the food experience. Research showed that 36-48% of meals were thrown away. Now, by introducing an improved service where food is served almost as in a restaurant, this has been reduced to just 2.5% while patients still have a choice of meals, also there are indications it might also have a positive effect on their recovery time. These results are so positive and the solution so easy to implement that multiple organisations in the hospitality sector are seriously interested in changing the food service according to this concept. The initiative at this hospital was recently rewarded the No Waste Award 2011, for the most innovative initiative to reduce food wastage in the business sector."

**International co-operation**  
In addition to projects in the Netherlands, international co-operation is also on the agenda.

*"Reduce waste  
by improving quality  
of meals"*

Toine Timmermans: "We participate in the Northwest European inter-regional 'GreenCook' project, which seeks to reduce food wastage. The aim is to change consumer behavior and apply supply chain concepts that improve efficiency. In conjunction with our 11 GreenCook partners, supply chain players and other stakeholders, we have set up innovation projects and pilots that focus on supply and demand matching, improved re-use of potentially unsold products and interaction with consumers. The co-operation is a first step towards a more integral European approach."

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# AlgaePARC

## *a leading European test centre*

**Microalgae are very attractive for the purpose of producing energy-rich molecules and they can play an important role in the sustainable production of raw materials for biodiesel. In AlgaePARC, research is being carried out to optimise algae production.**

"AlgaePARC has been set up to fill the gap between fundamental research on algae and full-scale algae production facilities," says Food & Bio-based Research's Maria Barbosa. "We compare present technologies and develop new reactor concepts and process control strategies to achieve lower production costs and

energy requirements, as well as gain knowledge for the design and process control of large-scale microalgae facilities."

### **Sustainable resource**

Algae are photosynthetic micro-organisms that can live in various aqueous environments, such as saline or seawater and therefore do not compete with cultivated farmland. The productivity of these photosynthetic microorganisms in converting carbon dioxide into carbon-rich lipids greatly exceeds that of agricultural oilproducing crops. Sunlight is their energy source and they have a low water footprint, and are very efficient in using waste streams as

a nutrient source. As such, they could be used to clean waste streams by removing nitrogen and phosphate, and using flue gas as their carbon dioxide source.

Up to now, commercial applications of microalgae have been limited to high-value compounds such as food and feed supplements, natural colorants, polyunsaturated fatty acids and cosmetic ingredients. To enable their use for the production of bulk products for the energy, chemical, food and feed sectors, production volumes need to be greatly increased from today's low levels and costs need to be reduced. This requires new knowledge and technological developments.



### **Scaling up**

Programs are being carried out globally to develop the technology needed to expand algal production from a craft to a major industrial process. Although large-scale microalgae production is non-existent for bulk applications, recent advances—particularly in the methods of systems biology, genetic engineering and bio-refining—present opportunities to develop this process in a sustainable and economical way within the next 10 to 15 years.

At Wageningen UR there are currently several ongoing research projects on microalgae. "A lot of basic knowledge is generated from fundamental research projects, which focus on individual elements that need to be integrated and applied on a larger scale," says Maria Barbosa. "There is an urgent need to implement the process at a larger scale as quickly as possible and it would be tempting to go directly to the demonstration stage, or even to full-scale plants. But there is a high risk factor and for that reason we are respecting the scaling-up design rules and saving time by starting pilot research in parallel to the laboratory research."

### **On-going pilots**

AlgaePARC pilots are presently being developed in order to obtain direct practical experience. Based on state-of-the-art technology, these pilots reflect the present development of several reactor concepts at laboratory scale by different research groups and companies. They will enable a rigorous comparison between systems, selection and, ultimately, the development of an improved system and process. There are currently four large (24 m<sup>2</sup>) and three small (2.4 m<sup>2</sup>) outdoor pilots. "The large ones

allow the study of the most important fundamental aspects for photobioreactor scale-up and operation," says Maria Barbosa. "They will serve as the basis to build up the knowledge required for the development of new, more competitive systems, processes and strategies for scaling up. The smaller systems will be used to screen species and to test different feedstocks and reactor concepts, while exploring new ideas. If promising results are obtained in the small systems, we would then be able to scale up these systems immediately to a larger scale. The test facility is just the start of what should become Europe's leading algae research centre."

Industrial partners participating in the five-year program that started at the AlgaePARC in 2011 include: BASF, Exxon Mobil, Neste Oil, PDX, SABIC, Synthetic Genomics, Drie Wilgen Development, GEA Westfalia Separator, Nijhuis, Proviron, Simris Alg, TOTAL, DSM, Heliae, Paques, Roquette, Staatsolie Suriname and Unilever.

"This important project will provide us with new insights into the technologies and operational methodologies required for successful large-scale microalgae production," says René Draaisma of Unilever Research & Development. "The knowledge and expertise of our research partners, Wageningen UR and Food & Biobased Research, particularly with respect to operation and development of photobioreactors, will contribute to the cost-effective and sustainable production of microalgae in the coming decade."

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# THE RECYCLING of plastic packaging waste

Dutch households annually produce about 4.7 billion kilograms of municipal solid refuse waste and bulk solid wastes, including about 420 kilotonnes of plastic packaging. A new report based on work carried out by Food & Biobased Research, throws light on future scenarios for plastic recycling in the Netherlands.

Since 2005, the responsibility for collecting and re-using part of this plastic packaging waste in the Netherlands has been firmly with the article producers, whose operator is the Dutch company, Nedvang. Waste retrieval is both via source separation and commingled collection, but currently the emphasis of Dutch legislation and is on source separation.

## State of the art

Today, various waste collection systems are applied to post-consumer packaging waste, such as kerbside collection and waste-container collection, after which it is centrally sorted and processed. Most of the material is recovered, but to a less-

er extent it is also used for energy recovery. A limited number of waste companies are currently equipped to recover plastic packaging from municipal solid refuse waste (MSRW) - a process known as material recovery from commingled, collected MSRW. This process is currently best known for the recovery of metal packaging from municipal solid waste using magnets for ferrous metals and eddy-current separators for non-ferrous metals. In fact, plastic packaging can also be selectively recovered using near-infra-red sorting machines, which occurs in Germany, France, Spain, Austria and, since recently, in The Netherlands.

## The way ahead

Within the Top Institute for Food and Nutrition project 'Post-consumer Packaging Recycling', scientists of various research institutes, including Food & Biobased Research in The Netherlands, co-operate to study material recovery from commingled, collected MSRW, both objectively and independently. Currently, three PhD students and three researchers are working on the process technology

of waste separation, sorting and reprocessing, the logistics of waste plastics and the re-use of recovered plastics in various applications. Their work, including the complete scientific descriptions of the mass streams within the various recycling schemes for plastic packaging waste, is nearing completion. These descriptions, or so-called 'mass-balances', otherwise known as collection and network models, will help to shape recycling strategies based on future scenarios for plastic recycling in the Netherlands, the first large public report on which was published in December 2011.

Recently an external mid-term review has confirmed that the project is well on track. The reviewers agreed that sound research is being carried out and now just past the midway mark, it's time to prepare for publication and dissemination of the results. The reviewers were impressed with the project and expressed their interest to continue their involvement.

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## Innovation boost for Chilean food industry

Together with Wageningen UR, the Chilean government is boosting knowledge development and consumer-oriented innovation in the food industry. Founded in 2011, the International Centre of Excellence Food (ICEFOOD) aims to increase innovation within the Chilean food industry and give added value to export products. Food & Biobased research plays a prominent part with 5 major projects.

### Investing in innovation

For years, Chile has been the world's largest fruit exporter: grapes, apples, avocado. Higher product quality, better use of by-products and higher economic value will strengthen the industry and help it to remain a strong player in the global market. ICEFood essentially builds a bridge between

fundamental research and food-industry product development. It will boost innovation by increasing product quality and consumer confidence in Chilean products through better food safety, adding value to products through improvement of storage life, and introducing sustainable production while reducing waste.

The Chilean government recognized our strong track record in public-private partnerships and knowledge transfer. Operating from an office in Chile, ICEFood starts as a virtual institute that will carry out research both in Chile and The Netherlands. A 10-year program will take off in spring 2012, in which the Chilean government, participating knowledge institutes and the business world have invested a total of 45 million US dollars.

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## Towards a biobased replacement for PET

**Biobased polymers that can potentially be used as a replacement for polyethylene terephthalate (PET) in applications, such as drinking bottles or fleece fibres, are highly desired. A 'plant' PET bottle comprising about 30% of renewable feedstock is already being marketed by Coca-Cola, but the next challenge is to make a 100 per cent biobased PET bottle. Together with its industrial partners, Food & Bio-based Research is exploring biobased building blocks for producing fully bio-based PET-like materials.**

A substance that shows huge potential for this purpose is biobased furandicarboxylic acid, a terephthalic acid look-alike for which worldwide research

has focused almost exclusively on developing routes starting from fructose and glucose. But potential producers and end users of biobased products are increasingly looking for products resulting from non-edible agricultural side streams - a route in which Food & Biobased Research is supporting various industries.

In co-operation with the Brazilian companies Braskem and Petrobras, for instance, it is developing a promising route to furandicarboxylic acid via sugars derived from bagasse - the non-edible side products of sugarcane production. "Although different production routes might be potentially preferable for other regions, the technology we have developed is highly suitable for further explora-



tion within the Brazilian context," says Jacco van Haveren, Food & Biobased Research's Programme Manager Chemicals.

Current research includes two recently granted projects within the Dutch Polymer Institute for the exploration of furandicarboxylic acid as a monomer in various polyester-type materials.

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# QUEST II

## *Container refrigeration with a difference*

Each year around a million reefer containers are shipped around the globe, carrying perishable commodities such as fruit, flower bulbs and meat. Together these cause CO<sub>2</sub> emissions of approximately 4 million tonnes per year. Rising fuel prices and growing concerns about greenhouse gas emissions mean there is an increasing interest in the reefer unit energy efficiency. The QUEST II (QUality and Energy in Storage and Transport) project has produced an effective and timely solution.

The new QuestTM II (patent pending) control methodology for container refrigeration units is the result of close co-operation between Food & Biobased Research, the shipping company Maersk Line and the refrigerated container unit manufacturer Carrier Transicold, and is the culmination of a four-year project to reduce the energy consumption of refrigerated containers by 65 per cent without any adverse effect on cargo quality. Quest is a methodology that controls the refrigerated container unit based on the real climate control requirements of the cargo. Quest II builds on an earlier project that was completed in 2007 and is easy to implement in containers because only the refrigeration unit's software needs to be updated.

### **Huge energy savings**

Quest II saves energy by improving control of two important components: internal air circulation and the compressor. Internal air circulation is adjusted to actual circulation

required. Air circulation will run at full capacity when necessary, but at lower heat load the air circulation rate may reduce to about 10% of its maximum capacity.

*“Quest saves 500,000 tonnes of CO<sub>2</sub> emission yearly”*

Apart from that, Quest II reduces energy consumption by controlling the compressor more efficiently. “In essence, Quest II improves the chilled-mode energy efficiency by avoiding inefficient part-load operation of the compressor and optimizing evaporator fan speed with heat load,” summarizes Leo Lukasse.

Maersk Line started using Quest II in 2011 and it is estimated that it will reduce the company's yearly CO<sub>2</sub> emissions by 500,000 tonnes. CO<sub>2</sub> saving from Quest II is comparable to CO<sub>2</sub> emission of cars driving three billion kilometres, or the effect of replacing 2.4 million light bulbs with energy saving bulbs.

Besides taking an active part in protecting the environment, Food & Biobased Research's project partner, Maersk Line, is also enthusiastic about what the project means for its customers. “The Quest project is part of a long-term environmental strategy, recognizing the fact that environmental innovation has to be run on an escalating level in the future,” says Maersk Line's Morten Baerentz. “Assuring that we are one step ahead in technological innovation makes it possible for us to keep improving the services offered to our customers, so they will also enjoy the long-term benefits of Quest II.”

### **Temperature critical to quality**

The effect of Quest II on produce quality was thoroughly investigated for a range of products, both in labscale tests and in hundreds of field trial shipments. Labscale testing was performed in our post-harvest research facilities with banana, pineapple, kiwi, grape, iceberg lettuce, lily bulbs and lamb meat. The field trials included more than 15 different commodities, including apple, banana, garlic and potted plants. Neither the labscale tests nor the field trials revealed any adverse effect of Quest II on produce quality.

Food & Biobased Research will continue to innovate in the cold chain. Potential areas of activity include the re-use of the Quest II knowledge gained in adjacent fields and further improvements in the control of refrigerated containers.

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# More mushroom in the jar



**Eddy Teernstra**  
Lutèce

**Wageningen UR Food & Biobased Research studied a factory belonging to Lutèce, a company that bottles mushrooms. This led to a new production process that is both cheaper and more environmentally friendly.**

When you fry mushrooms, they shrink. The same thing happens in the factory. Almost thirty percent of the mushroom evaporates, in a manner of speaking. And that is a lot, especially if you are bottling mushrooms on a large scale, as the Limburg company Lutèce has been doing for more than a century. Of the 100 million kilos processed every year, roughly 70 million kilos end up in the jars.

So Lutèce wanted some research done to see whether more of the mushroom could be kept after processing. "We were due to replace a number of our machines and we wanted to know whether we could strike a blow for efficiency at the same time," says Eddy Teernstra, director of operations at Lutèce's biggest factory, in Velden.

In 2007, Lutèce asked Jan Broeze and Miriam Quataert at Wageningen UR Food & Biobased Research to examine the whole production process at the factory, to delve into the scientific literature on each part of the process, and to sit down with eight production staff members and process technologists to document their experiences. This was a special assignment for Food & Biobased Research. "Normally we study one component of a food processing system, experiment with it in our lab, and then give advice," says Broeze. "This time we had to look at the process as a whole and come up with an analysis of its strengths and weaknesses. The discussions with the people on the work floor were particularly useful, giving us a good overview of the production process."

## Water channels

The results are impressive. Broeze and Quataert advised the company to keep part of the process the way it was, but to change other parts radically. Lutèce would be better off transporting the newly blanched, still steaming mushrooms through the factory in water-filled tubes than on open, dry conveyor belts. This entailed an investment of two million euros, but Lutèce had recouped that

in just one year. "Sometimes advisors are too optimistic about the changes they suggest, but this time it was the other way round. The returns were even higher than expected," says Teernstra. This leaves two to three percent more of the mushrooms over after the bottling process. But these investments also reduced the energy bill and the tax bill from the water board. The waste water at the Velden factory is a good deal

cleaner now. With the new production process, in full swing since 2010, there is less leaching from the mushrooms. "This has brought the waste water tax down by 20 percent," says Teernstra.

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## VALUE: more efficient processes and higher product quality

Value is lost within every organization, e.g., due to processes that are not optimised, too much water usage, microbiological deviations, and energy usage, or products deviating from specifications. With VALUE, Food & Biobased Research offers a unique concept whereby these problems can be tackled using the latest scientific insights.

VALUE is applied to carry out

improvements in the areas of product quality, energy and water usage, microbiological deviations, variations in processes, throughput time / logistical optimisation and carbon footprints.

As indicated in the main article, VALUE has brought Lutèce major yield improvements, with lower costs for energy and water. This

is just one example of how recent scientific insights can be coupled to practical solutions, leading to increased value for your organisation.

If you want to learn more about the VALUE concept, please contact Ben Langelaan ([ben.langelaan@wur.nl](mailto:ben.langelaan@wur.nl)).



# Smart agri-food chains

**Reliable and accessible information about the history, value and storage life of flowers and agro-food products is currently unavailable. But with new and still to be developed knowledge, 'fresh' chains can be organised in a more dynamic way, new services developed and better guarantees offered to consumers with regard to the origin, taste, ripeness, shelf life, vase life and nutrition value.**

With its main port of Rotterdam and Amsterdam (Schiphol Airport), and various green ports, there is a world-class horticultural cluster available in The Netherlands. So far already this has been a great competitive advantage, but that position is about to get even better through innovation and improved chain management. The development of up-to-date supply chain control systems for optimal quality and safety control, and tracking and tracing will greatly improve the availability of information about fresh products at any instant and in every link of the fresh

chain. Uniform and transparent product information will be available to the consumer about nutrition and health aspects, as well as the origin, manner of cultivation, transportation and sustainability indicators.

## Current innovation work

There is much scope for improvement in techniques and methods for better guidance of the chain and for transfer of information to consumers. These are currently being developed and in fact many are available as prototypes. One example is the development of a new generation of active, low cost, RFID tags equipped with specific sensors, whereby in different chains product variables can be measured during the process. In coming years, these will find application mainly in dynamic chain-management systems. With expected

cost reduction of RFID tags in the near future, these will also be applied to provide consumers with relevant information about nutritional value, allergy causing ingredients, shelf life, vase life, and about origin, footprint and mode of transportation, etc.

Based on existing knowledge and a number of variables, such as available types and varieties, packaging, conditioning, transportation modes, it is now possible to determine how consignments should be sent in the most sustainable way, whether by ship, plane, train, inland waterway, or road transport. However, as fresh produce is characterized by large biological variations that are difficult to manage, it is of great importance to get more grip on the initial quality of the product in the distribution chain.

## Commercial participation

The basis of current knowledge is built on a programme with Biobased

Research projects, Flower Life, VitaPlant, Compact & Droog, Q-cotrans and Freshcorridor, all target fresh-chain optimisation, sustainability and smart chain management. These projects build on, among others, the EU 'Pasteur' project, in which a consortium led by NXP is developing the next generation RFID chip. Food & Biobased Research is developing the quality models and in certain projects will carry out business pilots with the chain members. In the NanonextNL projects, 'Sensors for detection of volatiles' and 'Quality & safety', new sensors and analysis building blocks will be developed by consortia for intelligent fresh chains.

"Quality, taste and shelf-life of fruit and vegetables in retail is just like a puzzle," says Rob Wessels of Bakker Barendrecht, one of the largest fruit and vegetable companies in the Netherlands. They process over 2,000 tons of fruits and vegetables a day, or nearly 70 million crates a year.

"We find the major pieces pre and post harvest and try to form the best picture we can as fast as possible. By combining information about chain parameters and using that in smart models we can make a step towards achieving better quality on the shelves. Predictable and stable shelf-life and quality in complex chains can only be achieved with an intelligent system that handles all the dynamic factors. And that is what we expect to achieve from this co-operation with Food & Biobased Research."

To improve and speed up implementation, the current consortia are extended with participants from the entire horticultural and logistics sectors. And as quality is ultimately determined by every link in the chain, the entire chain has been involved from grower and importer to distribution and retail.

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# Biobased Performance Materials

**In the Biobased Performance Materials programme, more than 30 businesses and 5 knowledge institutions are currently working together on new and improved bio-based plastics to compete with fossil-based plastics. Initiated and coordinated by Food and Biobased Research - one of the top-3 contract research organisations in Europe in this field of expertise – the programme is co-financed by the Dutch Ministry of Economic affairs, Agriculture and Innovation.**

"The Biobased Performance Materials programme is more than just research projects," says Christiaan Bolck of Food & Biobased Research. "Symposia bring together companies and

scientists from various research institutions. Publications, such as those on currently available biobased construction materials and Biobased Plastics 2012, give essential overviews.



We also produce tuition materials for students of plastics technology. Furthermore, we plan to set up some 20 projects in partnership with current partners, but also new businesses are invited to join."

## Main focus

The main focus of the research is on improving the temperature resistance and the mechanical properties of biobased materials, while reducing their sensitivity to water and lowering their cost price. In addition, these new bio-based plastics are being tested for sustainability, which includes comparing them with materials based on crude oil. Applications range from plastic bottles, household equipment and parts for cars, trains and planes, to computer housings, paint, floor coverings and packaging materials.

## Global leaders involved

The core of the programme currently consists of eight related projects that will boost collaboration between large and small companies. This will enable an entire value chain to be set up, from biomass to final product. Projects range from investigating how to make bulk chemicals from



plant residues and sugars, to finding human-friendly composite resins. "Composite resin has many applications, so one project involving the internationally renowned company, Cargill, targets a harmless and environmentally friendly vegetable-based composite resin without producing toxic styrene fumes," says Christiaan Bolck.

## Food giant

The food giant, Heinz, is participating in two projects. One examines the use of Chitin (a substance that has a strong antibacterial effect and can be obtained from the shell of crabs and shrimp) in biocompatible chitosan films and materials for packaging that works against food spoilage. The other project looks at a number of bio-plastics, in particular those used for injection moulding applications, to try and determine their precise characteristics.

Some bioplastics require modifying to increase the range of applications. For example, those made of polylactic acid (PLA) are rather stiff and prone to breakage, which is why one project seeks to make bioplastic tougher and examines fatty acid derivatives

with rubber-like characteristics. Another project seeks to find a less permeable PLA plastic suitable for carbonated soft drinks and juices.

## Science-based multinational

DSM is a partner in a project to find suitable polymers from new monomers for technical plastics and coatings. "The monomer building blocks come from vegetable oils and fats and from sugars, and their characteristics depend on how they are mixed," says Christiaan Bolck. "Strong polymers resistant to high temperatures are required for construction materials, electronics and car parts. Those that combine well with pigments and behave well in water, or melt at low temperatures, are required for coatings." DSM is also a partner in a project investigating how to make bulk chemicals, such as styrene and acrylic acid, from vegetable raw materials.

## World's largest paints & coatings company

AkzoNobel, the world's largest global paints and coatings company, is participating in a project to make polymers for powder and water-based industrial coatings from fatty acids and sugars. "Powder coatings are

applied at room temperature, after which they have to reach a high temperature, which is why the polymers have to be glass-like and not have a crystalline arrangement. The polymer must also have reactive end groups for the chemical reaction during heating," adds Christiaan Bolck. At the end of this project, the participating companies must be able to apply the technology immediately.

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# Customised Protein Nutrition

**Customised nutrition - the targeted nutrition of a subgroup of individuals - is made possible due to enormous advances made in our understanding of how dietary compounds affect gene expression and interact with physiological processes in the human body. Central to the Customised Protein Nutrition program is the use of proteins in food and feed, with the interactive focus on technology, gut functioning, and consumer acceptance. Food & Biobased Research - in partnership with Human Nutrition, Animal Sciences and Social Sciences groups of Wageningen UR - is using its broad expertise to meet the industrial and scientific challenges.**

"Novel proteins in foods and feeds need to be able to meet, or exceed all functional properties of current conventional protein sources," says R&D manager Marchel Gorselink.

"A future industry focus will therefore have to be on new technologies and processing to incorporate proteins in matrices to create highly palatable

products that provide not only nutritional and physiological benefits, but also provide sensory satisfaction for consumers."

## Proteins vital for health

For humans and animals, amino acids in protein are a source of energy but more importantly, deliver essential building blocks for the body. Proteins play an important role in several domains of human health. They have functional benefits for gut health and they also play a key role in body-weight regulation and potentially the treatment of obesity.

Moreover, for specific consumer groups, such as children and the elderly, protein intake is essential for development and longevity. These are drivers for the food industry to either increase the protein content of existing products, or to focus product development on novel protein-enriched products.

There are many challenges related to these protein enriched food innovations, and the main aim of this scientific program is to explore potential new protein sources in the area of process and product technology, functioning in the gut, and the translation to and acceptance of consumers.

"More important, these scientific challenges need guidance and therefore, cooperation of the industry. So they are invited to join in this program, and help to make the next step in the area of sustainable protein sources", continues Gorselink.

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## Searching for alternative sources

The world faces a global protein shortage if the consumption of animal protein continues to increase at current rates. Solutions being investigated include more efficient use of existing protein sources, completely replacing animal proteins by plant proteins (mainly soy, lupine and pea) through the development of, for example, a new generation of fibrous meat-alternatives, and hybrid products where part of the animal proteins is replaced by plant proteins, e.g. meatballs with 30% plant protein. Novel alternative protein sources under investigation include insects, algae, seaweed and food-industry by-products, as well as by-products from biorefinery processes.

# Lignin: a bright future in store



**Despite its importance in plant tissues, lignin is often discarded as a low-value waste product in many biorefinery processes, such as the production of chemicals, or bio-ethanol, in which lignin is called 'non-fermentable'. However, lignin is suitable for various value-added applications, including glue for plywood and in building blocks for (bio)polymers.**

Production of 'green' chemical building blocks from lignin is seen as an important future development because large parts of consumer products can be made from these and the results of recent research has identified promising opportunities. "By analysing its specific properties, the suitability of lignin can be predicted for a number of applications," says Richard Gorselink of Food & Biobased Research. "A good example of a commercial application jointly developed by the Swiss lignin producer, Greenvalue SA, and Food & Biobased Research, is the partial substitution of a synthetic binder by lignin for gluing wood panels. Furthermore, lignin valorisation into value-

added applications attracts many industrial companies and via the Wageningen UR Lignin Platform, we are generating knowledge about optimal uses for lignin."

## Lignin Platform

The Wageningen UR Lignin Platform comprises scientists from diverse disciplines and various industrial sponsors, including Genencor and DSM. The joint objective is to promote interdisciplinary research on the valorization of lignin for the industrial production of lignin-derived chemicals and materials. As DSM has a strong biobased focus, Food & Biobased Research is the logical partner with

its broad knowledge on lignin uses and the entire value chain. "Due to its chemical composition and low costs, lignocellulosic biomass offers many possibilities as a natural resource for the chemical industry," continues Richard Gorselink. "To substantially increase the use of lignocellulose, however, further development is necessary for novel thermochemical and biochemical conversion processes and integral biorefinery concepts required for the co-production of chemicals, biofuels and electricity."

## Lignin biorefinery project

Lignocellulosic raw materials consist chiefly of cellulose, hemi-cellulose and lignin. The cellulose and hemi-cellulose fractions can be used as a source of sugars for the fermentation of industrial chemicals as well as fuels such as bioethanol. But this leaves a large residual amount of lignin, which has been mainly used as an energy source in paper pulp mills.

However, due to its chemical nature and the presence of a large amount of functionalised aromatic structures, lignin may be an attractive raw material for aromatic compounds, reducing the need for fossil resources and CO<sub>2</sub> emission.

The LignoValue biorefinery project targets valorization of the lignin fraction via the production of phenols, performance products and fuel additives. "Valorization of lignin will be the key issue in the further development of biofuels production from lignocellulose," says Richard Gorselink. "Conversion of lignin to chemical feedstocks will positively influence the economic feasibility resulting in a substantial decrease of the production costs of bio-ethanol."

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# NovelQ:

# *mild processing technology*

**A growing number of food companies nowadays use mild preservation Technologies to improve shelf life without compromising on other quality attributes. The knowledge that has provided the framework for development and market introduction of mild preservation technologies such as High Pressure Pasteurisation, cold plasma and Pulsed Electric Fields in the food sector, has been developed within the European NovelQ project. A critical success factor has been the inclusion of food companies and equipment manufacturers in an Industrial Advisory Platform. Although the NovelQ project has formally ended the IAP remains open for new members.**

#### **Why mild processing?**

There are numerous promising benefits attached to mild processing methods and treatments. For a start, they use less energy and water while making more efficient use of raw materials through better yields and less waste. They also make more

efficient use of packaging materials and reduce production losses in the food chain. As if this isn't enough, they also reduce chemical preservatives. But most importantly, mild processing methods maximize the quality and shelf life of food products.

One such method is High Pressure Processing (HPP), a preservation method that has been a key area of involvement for Food & Biobased Research and for which it developed pilot equipment for high-pressure pasteurization and sterilization. A key benefit of HPP is that food structure remains intact as the high pressure is applied evenly. "There is a big demand from consumers for food to retain its taste, texture and quality," says Miriam Quataert, senior scientist for food design and structuring. "So, together with industry, we focused on applications to preserve food in an optimum way while bringing down the costs of what is a relatively expensive technique."

#### **Improved understanding**

At the start of the NovelQ project, a series of knowledge gaps were identified for the techniques of high-pressure high-temperature, pulsed electric field, cold plasma, and also of packaging in relation to novel processing. These were subsequently addressed and a major breakthrough was achieved in understanding kinetics and mechanistic insights, especially in the areas of food texture, food chemistry, microbiological inactivation mechanisms, bio-chemical side-effects and risks, etc.

A total of over 135 scientific publications on novel processing technologies were written. Similarly, over 60 publications in professional journals were published to inform industry on the outcome of NovelQ. In addition, over 20 public workshops were held in different regions in Europe. The workshops were organised alongside large international events to attract a large group or as stand-alone workshops for a specific audience.

#### **Industry Advisory Platform**

Key to the project's success has been the Industry Advisory Platform, which was created to discuss with industrial stakeholders from outside the project consortium the impact and potential of novel processing schemes and to provide feedback. Set up at the start of the project, the number of industrial members made up of food producers, equipment suppliers, other interested parties, totaled 89 when the project was finalized. Activities included industry-oriented workshops and meetings, the NovelQ website,

newsletters, business cases featuring novel processing technologies and a decision support tool to select the most appropriate novel processing technology. IAP members were subsequently invited to participate in short demonstration trials on pilot scale possibilities to test their products by using specific novel processing technologies / applications.

*"Key to the project's success has been the Industry Advisory Platform"*

The above concept significantly contributed to the technology transfer and as a consequence has been implemented by various EU projects.

"Participation in NovelQ and in the Industry Advisory Platform has improved our understanding both of the latest developments in novel processing and the potential needs of the food chain and industry," says Govert van Oord Managing Director IXL Netherlands B.V. "The parties who significantly contributed to the project also became clear and cooperation with the NovelQ consortium has encouraged our development of pilot equipment for pulsed-electric-field applications for cold pasteurisation and e-Cooking technology."

#### **Applications**

Based on the results of NovelQ, Food & Biobased Research developed together with industry various applications of high pressure processing, pulsed electric field processing, plasma decontamination and radio frequency heating for enhanced shelf life and quality of food products. "The state of the art research and pilot facilities, and the strong network in Europe inspired already various food industries to investigate the possibilities of novel processing," says Ariette Matser, senior scientist novel processing and coordinator of NovelQ. "Together with industry, we are working at Food & Biobased Research on various applications of these processes to improve the shelf life and quality of food products. Safety and performance are at this moment the key issues.

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[www.novelq.org](http://www.novelq.org)



# BIOPLASTICS



**In the Biobased Materials Performance program, knowledge institutions and companies collaborate on new biopolymers and applied research to improve the properties of existing bioplastics, or 'green plastics'. With the development of these new bio-based materials, Wageningen UR Food & Biobased Research and its partners are making a valuable contribution to a Biobased Economy.**



**Jan Noordegraaf**  
Synbra Technology

Collaboration on green plastics enables these biobased materials to compete more with petroleum-based plastics in terms of material properties and price. Bioplastics are applicable in plastic products ranging from bottles, household appliances and automobile parts, to paint, floor coverings and packaging materials. And one of the most sustainable biobased and biodegradable raw materials for green plastics is PLA (polylactic acid).

## New 100% biobased technology

On-going collaboration with Food & Biobased Research's industrial partners is taking place in various projects. One such partner, the Synbra Group, has a leading position in Europe regarding Expandable Polystyrene (EPS) for sustainable insulation systems. Also for industrial products and solutions for a wide diversity of markets. The group's in-house polymerisation and R&D facility and centre of excellence in materials and product development, work closely with Wageningen scientists on green plastics.

## Innovative products

Two of the Synbra group's recent innovations include biodegradable

expanded polystyrene and second-generation PLA. In 2011, a plant built by Synbra Technology in the Netherlands became the first plant to use a new polymerization technology for PLA when it started industrial production of its second-generation PLA grades. This secures for Synbra an integrated raw material stream for the further development of a foamed product made from this PLA. The new plant processes L & D Lactides from Purac, produced from 100% biobased, GMO-free, plant feedstock and has an annual capacity of 5,000 tons.

"In 2006, we wanted to do what we can as a company to help in the climate debate and decided to target a change from oil based to bio based. We approached Food & Biobased Research with our ideas and thanks to them we are where we are today," says Jan Noordegraaf, managing director of Synbra Technology.

## Sights set on European leadership

To capitalize on the polymerization capability, Synbra is producing commercial PLA grades for various applications, such as compounding, injection moulding and extrusion. The company's GMO free PLA is called a second-generation PLA due to its high temperature resistance. With this move, Synbra intends to take a leading position in Europe as a supplier of sustainable and biologically degradable polymers from renewable sources. It has received the Cradle to Cradle Silver certification for the production of BioFoam and Synterra\*, which became the world's first PLA-based product and first bio-based foamed product to receive this accreditation.

## High-value applications for biobased plastic PLA

Two further projects that are part of the Biobased Performance Materials program, seek to improve the properties of biobased plastic PLA to make it suitable for new, high-quality applications. The HIPLA (High Impact Poly Lactic Acid) project aims to create stronger and tougher plastics from PLA. To overcome the inherent brittleness and achieve toughness (high impact resistance), a new innovative process is being developed. In this process, PLA is modified with fatty acid derivatives by reactive extrusion. This melts and mixes plastics (polymers) well and then fixates the impact modifier. Thus a whole new biobased plastic is created that is suitable for applications ranging from household appliances and packaging to car parts.

*"Target a change from oil based to bio based"*



## Project partners

HIPLA: Synbra Technology, Croda Europe Ltd, HSV Technical Moulded Parts and Apeldoorn Flexible Packaging Technology.

PLAastic bottle: Synbra Technology, Eindhoven University of Technology, RedOrange Food, Purac Biochem, Croda Europe Ltd, FKuR Kunststoff GmbH, Desch Plantpak and Constar International Holland (Plastics).

\* BioFoam and Synterra are registered trade-marks of Synbra Technology bv, Etten-Leur, The Netherlands

# Bringing clarity to the bio-based economy

The bio-based economy is of interest to politics, business and the media alike, and has connections to multiple top sectors. Not surprisingly the theme is being developed jointly by several knowledge institutes and industry. This is being done under the direction of the largest business organisation in the Netherlands, the chemicals industry and the Bio-based Economy Program management of the Dutch Ministry of Economic Affairs, Agriculture and Innovation.

## Knowledge transfer

"Knowledge and innovation play a crucial role in the bio-based economy. Transferring this knowledge is also one of the most important tasks we address in our policy support program," explains Food & Biobased Research's Harriëtte Bos.



**Harriëtte Bos**  
Wageningen UR Food & Biobased Research

The issue is highly complex and there is an increasing need for accessible, factual knowledge in all aspects of technology and sustainability. Knowledge products are used in network meetings, newsletters and the websites ([biobasedeconomy.nl](http://biobasedeconomy.nl) and [groenegrondstoffen.nl](http://groenegrondstoffen.nl)) where many different aspects of the bio-based economy are explained. Also a web application explaining the present and potential production structure in a biobased economy was recently launched. This is available at [www.biobasedeconomy.nl](http://www.biobasedeconomy.nl).

## Publications

Another highly effective means of communicating information is the series of small booklets on the bio-based economy, which cover subjects such as bio-refining, sustainability of bio-based products, microalgae, and bioplastics.

Harriëtte Bos: "These booklets are used mainly by companies and government. However, in some cases research institutions like to use them for teaching about the biobased economy. We also plan to continue with this popular series in 2012".

## Expertise for studies

Scientific studies provide important information for future policy choices by both companies and the government alike. For example, comparing

the sustainability impact of different applications, such as biofuels versus bioplastics. "Sustainability questions play an increasing role. So, it is desirable to anticipate questions about the sustainability of the non-food application of biomass, such as bio-based products," concludes Harriëtte.

A study is being carried out on how the bio-based economy will affect the Dutch economy. Other studies target the analysis of promising bio-based chains. Furthermore, new models are being used to give more insight into their financial and economic potential.

Peter Besseling, Program Department Biobased Economy of the Dutch Ministry of Economic Affairs, Agriculture and Innovation (EL&I), says, "The Biobased Economy policy support program is very important for our department. The results and products from the program help us in shaping the biobased economy in the Netherlands. The policy needs support for decision making in areas such as sustainability. Access to knowledge for policy makers is also very valuable for a complex issue such as the bio-based economy."

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## Bulk chemicals from biomass

Biomass-based routes to bulk chemicals are expected to make a significant impact on their production within 10 years and a huge impact within 20–30 years, according to a case study for the Port of Rotterdam published in early 2008 in the peer reviewed journal *Biofuels, Bioproducts and Biorefining*, which is listed in the top 10 of recently most referenced publications. "Early in 2008, we anticipated a clear short-term substitution potential for oxygenated bulk chemicals, such as ethylene glycol and propylene glycol, iso-propanol and acetone, butylene and MEK, and for replacement of MTBE by ETBE," says Food & Biobased Research's Jacco van Haveren.

"This implied a short-term substitution potential of about 10–15% of fossil-based bulk chemicals by biomass-based bulk chemicals. Furthermore, in the next 20 years a huge potential was foreseen for bio-based production of commodity chemicals like ethylene and vinyl-chloride, with the first commercial implementation of this taking place in areas with access to cheap ethanol and where ethylene production is not largely integrated with that of other platform chemicals. For aromatic biobased bulk chemicals, comprising 30–40% of all base chemicals, lignin was regarded as a longer-term biomass source for our aromatics."

Today, the biobased bulk chemicals arena is expanding rapidly and the short to mid-term potential is greater than previously thought. Since 2008, bioethylene is being commercially produced in Brasil, and not only lignin, but also cheap sugars are offering potential for biobased aromatics. In this context, Food and Biobased Research together with an industrial partner recently filed a patent application for the production of biobased aromatic acids, starting from specific sugars.

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# GreenRail

## a fast and reliable alternative

GreenRail is an initiative that organizes rail transportation of floriculture products via conventional rail links. Trading companies, retailers and wholesalers like to have an alternative for the transportation of their delicate products, but preferably it has to be fast, reliable, efficient, environmentally conscious and cheaper. The GreenRail network is highly suitable for the long-distance transportation of ornamental plants and flowers. It keeps products fresh over lengthening logistical chains, as new and more distant markets develop.

"Our primary role has been to perform research: simulation of various supply chains in our laboratories answering questions, such as, is the quality of the top 20 potplants assured in longer distribution chains compared to standard truck transport? By performing and guiding real world pilots together with our project partners, we have created a transport

protocol which is easy to use by transporters and exporters," says Food & Biobased Research's Henry Boerrigter. Under the GreenRail initiative, rail routes were established to Italy and Romania, and the feasibility of routes to Hungary, Poland and Switzerland proven. The project has resulted in a regular train transport service for the Dutch flower business. "The work of Food & Biobased research has been very helpful and the GreenRail project had far more shipments than originally planned. The critical success factor was a mental shift rather than only a modal shift," adds Michiel van Veen, chain advisor FloraHolland and projectleader of Green Rail. GreenRail is an initiative of FloraHolland and VGB. GreenRail is a partnership between the floriculture businesses (exporters), logistics service providers and knowledge institutes.

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# Feeding and caring for the elderly



Can malnourishment exist in the Netherlands? Can there be complaints about dinner, not by children, but by seniors? Is there a connection between both problems? Can they be solved without a further increase in health care costs, and at the same time an increase in the quality of life? These are questions addressed by the Food & Care programme in which more than 800 elderly people are participating in several projects involving both controlled lab and in real life situations.

## Institutional problem

The incidence of malnourishment among the elderly in Dutch nursing homes is about 25%. In addition, 43% of the residents are at risk of malnutrition (National Prevalence Measurement of Care Problems 2010). Scientific evidence shows that malnourishment is related to a slower recovery from illness, a higher intake of expensive dietary products and a higher need for personal care. Malnourishment not only negatively affects quality of life, but also contributes to high public costs in the health sector.

## Testing a solution

In 2010, the Dutch government called for a pilot experiment on reducing malnourishment involving the co-operation of nursing-home residents in the North Brabant area. The residents were offered a new meal concept where extra attention was paid to the food and a pleasant environment. The initial results were very promising indeed. "We found that residents stayed at the table longer (about 30 minutes), ate considerably more (30% more vegetables and starch products) and showed a clear trend towards a

healthier body weight compared with the control group," says Herman Peppelenbos of Food & Biobased Research.

*"Why should we give our patients food supplements?"*

## Follow-up study

In 2011, a follow-up study was carried out to significantly prove the positive effects of the pilot study. "The aim is to gain solid data on the reduction in malnourishment, improvement in quality of life and reduction in related costs," continues Herman Peppelenbos. "Over 200 elderly in 8 nursing homes are involved, with changes in meals and social ambiance being monitored in real-life situations over a period of 6 months.

## Seniors' consumer panel

Also in 2011, a seniors' consumer panel (SenTo) was set up in which

the sensitivity for taste and smell of over 700 elderly is tested. Segmentation between groups of elderly is possible, thus addressing different needs regarding health and taste perception. The panel has been involved in several product studies, including ready-to-eat meals and bread, and the results have already helped the food industry to improve and customize their products. Marco Wisse, director of Naarderheem nursing home, said: "Why should we give our patients food supplements when a tasty meal gives them all the nutrition they need? When our care home changed over from industrially-prepared meals to those prepared from biological and local produce, we saw our clients eat more often and they hardly experienced any unwanted weight loss. A tasty meal in a nice ambiance adds to the quality of life in our care home: eating and drinking contributes to physiological well-being, but also meets our need for social relations."

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# High speed quality assessment

Together with various machine builders, Food & Biobased Research's Intelligent Systems group is developing novel sensor modules for diverse machine-automation solutions in the Agrifood industry. The manual grading of seedlings at companies involved in plant growing and breeding is both labour-intensive, time consuming and expensive. Now, an automated system that uses 3D-vision techniques in combination with knowledge-based formalisms has been developed to grade seedlings according to their quality. The system has already been installed by Flier Systems BV at the Dutch nursery WPK, where the efficiency gains, financial savings and quality improvement are considerable. Similarly, a computer vision module is being developed

with Optiserve BV for a high-speed, bulk-sorting machine that will revolutionise the qualitative sorting of products. Equipped with color linescan cameras and near infrared hyperspectral cameras, the system uses a distributed cluster of computers for high-speed calculation of defects in real-time. Applications range from the potato processing industry to other fruit and vegetables, such as apples, carrots and cabbages and even hidden bruises can be made visible by the system.

Food & Biobased Research is also co-operating with Europe's checkout market leader ITAB to develop the technology for the world's first, successful, fully automated checkout system. This state-of-the-art



technology combines information from a number of sensors to create a 'digital fingerprint' of each scanned product. It does not depend on the presence of a barcode on a product, but uses information obtained from colour images, weight sensors, and spectrometers. The entire identification process takes less than one second per scanned article and is more accurate than the average manned checkout.

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[tinyurl.com/wur-marvin](http://tinyurl.com/wur-marvin)

## Co-production of biobased products improves biofuel competitiveness

The costs of producing biofuels for transportation (bioethanol and biodiesel) can be greatly reduced by combining biofuel production with the production of biobased building blocks for the chemical and manufacturing industry. This is especially important as most biofuels today cannot compete economically with the production of fossil fuels without subsidies. Co-products that can be produced from biomass alongside biofuels include waxes, ethylene, and proteins, which can be used in the chemical sector to replace current chemicals produced from petroleum, or in other sectors.

Rob Bakker of Food & Biobased Research explains: "With this study we have shown that the deployment of biomass for combined production of energy carriers and biobased products makes more sense economically, compared to conversion of biomass to biofuels alone. Therefore, co-production leads to a better market position of current biofuels and advanced biofuels that are now under development."

The study calls for creating a more level playing field for the application of renewable biomass in the energy and chemical sectors, which should

in turn accelerate the development of the Biobased Economy. A user-friendly economic model is now available that can be used by business leaders, policy makers and the general public in order to test the economic feasibility of six biomass-to-biofuel production chains. The study was commissioned by the Dutch Ministry of Economic Affairs, Agriculture and Innovation, and conducted in close collaboration with the Dutch Energy Research Centre.

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# EU grant boosts innovation in fibres

The EU granted a large project, named FIBEBIOTICS and coordinated by Food & Biobased Research, which aims at the development of tools to study the gut and immune effect of food compounds and food products. The final goal of the project is to collect sound scientific evidence for some specific food compounds which can function to support a health claim submission. At the same time the project will identify new strategies that can be broadly applied in the field of other food products that target the human gut and immune system. The project starts at January 2012 focusing on polysaccharides. The project will be a boost for the involved SME but will also be of interest for other food companies which can participate in our Industrial Platform.

### Innovations in the field of maintaining health

Polysaccharides are known for their health effects. Some Chinese Traditional Medicines, drugs and adjuvants are based on polysaccharides which can have direct effect on the immune system and of which others are likely to have a prebiotic effect that includes the microbiota as vehicle for the observed health effects.

Objectives of the project are:

- 1) a better biochemical characterization and an improved classification of bioactivity of polysaccharides,
- 2) a standardised tool to study fermentation and effect on the microbiota,
- 3) clear strategies to study the effect of polysaccharides on the innate and adaptive immune system on humans.

The innovative technologies and mechanistic background knowledge developed in this project can be of interest for many more compounds and food products targeted toward the gut and immune function and support the food industry in substantiation of health claims. EU KBBE recognized this project as very important, selected it from 30 proposals and granted it with 6€ EC contribution. The consortium consists of 4 Universities, 5 Research institutes and 8 SME companies from 9 different European countries. With this project, we further strengthen our capacities in the field of gut and immune function to be the research and innovation partner for the food industry.

**More information:**  
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# Biobased economy expected to grow

A common European vision on biorefineries for 2030 and a research road map up to the year 2020 were among the key deliverables resulting from the two-year European FP7 StarColibri project ([www.starcolibri.eu](http://www.starcolibri.eu)) in which Wageningen UR Food & Biobased Research played an active part. Aimed at overcoming fragmentation and promoting cross-fertilization in biorefinery research, the project forecasted significant growth for the biobased economy in Europe by 2030. "Biorefining, the sustainable processing of biomass into a spectrum of marketable products and energy, will be a major pillar of this growth, both now and in the future," says Food & Biobased Research's Bert Annevelink, who co-edited the reports. The European sector is predicted to evolve from established biorefinery operations for products like food, biofuels, paper and board, to a broader, more mature sector. "By 2030, biorefineries will use a wider range of feedstocks and will produce a greater variety of end-products than today." But there are some provisos attached to achieving the European biorefinery vision for 2030. "Future biorefineries need to be better integrated and more flexible, and operate more sustainably. This will only be possible if crucial bottlenecks along the entire value-chain can be removed," adds Bert Annevelink.

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



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.

'To explore the potential of nature to improve the quality of life'. That is the mission of Wageningen UR (University & Research centre). A staff of 6,500 and 10,000 students from over 100 countries work everywhere around the world in the domain of healthy food and living environment for governments and the business community-at-large. The strength of Wageningen UR lies in its ability to join the forces of specialised research institutes, Wageningen University and Van Hall Larenstein University of Applied Sciences. It also lies in the combined efforts of the various fields of natural and social sciences. This union of expertise leads to scientific breakthroughs that can quickly be put into practice and be incorporated into education. This is the Wageningen Approach. The domain of Wageningen UR consists of three related core areas: food and food production, living environment, and health, lifestyle and livelihood.

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