



CARBOHYDRATE
COMPETENCE CENTER



CARBOHYDRATE COMPETENCE CENTER

LEADING IN INNOVATIVE CARBOHYDRATE RESEARCH
IN THE NETHERLANDS

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**Gert-Jan Euverink,
University of Groningen:**

'CCC is a good example of how academic research and industrial interest can be arranged in joint research programs in such a way that both parties are able to meet their key performance indicators.'

**Henk Schols, Wageningen
University & Research:**

'The next step is to create a new generation of prebiotic carbohydrates to add to food components meant for infants and the elderly. I also expect breakthroughs with respect to the effects of nutrition on the immune system. It is up to the industry to take this new knowledge further and convert these finding into practical applications and improved or new products.'

WHO WE ARE

The Carbohydrate Competence Center (CCC) is the leading, international knowledge center in the interdisciplinary field of carbohydrate research. We develop new and high-value knowledge, promote innovation worldwide, and contribute to healthy and sustainable societies. To do so, we initiate excellent, pre-competitive, multidisciplinary fundamental research into carbohydrates in all its forms. We combine fundamental research with demand-driven, market-oriented innovation, eventually leading to new products, processes, and jobs. We organize research programs in public-private consortia and contribute in particular to research in the pre-competitive phase. The University of Groningen and Wageningen University & Research share the responsibility for CCC.



OUR DRIVE

CCC wishes to contribute structurally to the independent research aimed at global challenges, like health and nutrition, food security, biobased economy, and sustainability. Our drive is to bring together scientific, industrial, and commercial partners on an equal footing. Equally important is our ambition to make sure that all results are valorized and shared with all partners involved. Finally, we aim to spread the new knowledge resulting from the programs as widely as possible within and outside the CCC network.



OUR HISTORY

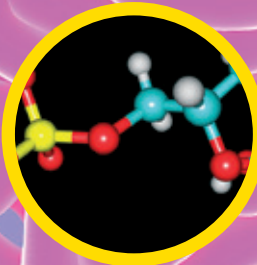
CCC was founded in 2008. The first CCC programs focused on the themes Health and Nutrition and Biobased Economy. These programs yielded a great many promising results, leading to follow-up research and even a number of patented applications. In ten years' time we have gained valuable knowledge and experience in a wide range of research projects concerning carbohydrates.

OUR STRATEGY

We wish to collaborate with all Dutch universities, sharing knowledge of and research into carbohydrates. Furthermore, we wish to reinforce the international position of Dutch knowledge institutes regarding carbohydrate research. In addition, we wish to expand our network to become a European knowledge network for top carbohydrate research.

Colja Laane, CCC:

'Within CCC it is my role to build bridges between science and industry and, if necessary, to act as a lever to keep things on track and to stimulate innovation. Since I have a lot of experience in the area of private-public finance and research, I feel quite at home as chair of CCC.'



**Lubbert Dijkhuizen,
University of Groningen:**

'Fundamental research results in the best of the best. Encouraging young scientists to do fundamental, free research often leads to the most surprising outcomes. Results that benefit both science and industry. We need each other, and we can help each other.'

WHAT WE DO

Our programs generally focus on developing new technologies which in turn may lead to the development of new products as well as at unlocking new knowledge about the behaviour and function of carbohydrates. Currently, we have carried out and completed successfully four programs: CCC 1 and 2, CCC ABC and CarboHealth.

By working together, communicating and sharing findings, methods and results, all participants were able to benefit from the multidisciplinary programs. A host of new knowledge, methods, and products became available to the academic world as well as participating industries.



CURRENT PROGRAMS

Our current programs are CarboKinetics and CarboBiotics. Both programs are the responsibility of CCC and the Dutch Organisation for Scientific Research (NWO) as part of the NWO CCC Partnership. CarboKinetics is directed at the improvement of health based on a better knowledge of the kinetics of carbohydrate utilization in the gut. CarboBiotics focuses on the positive effects of carbohydrates on gut health in relation to the international drive to reduce the use of antibiotics. Specifically, this program focuses on how prebiotics and probiotics can be used to improve human and animal health while lowering antibiotic use significantly. In 2018 a third program, CarboBased, was launched and this program focuses on creating new biobased products and materials as well as new building blocks from carbohydrates.

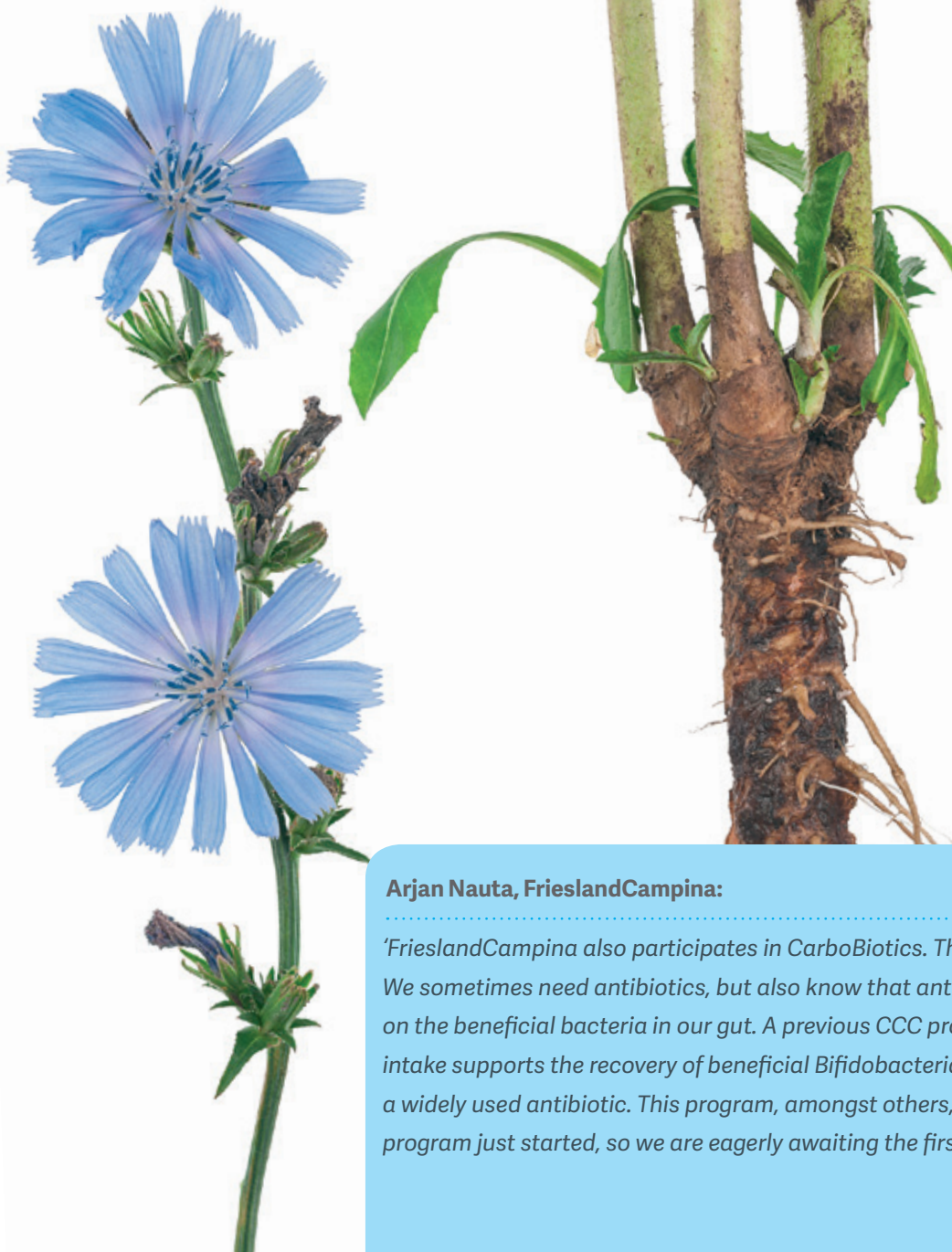


OUR PARTNERS

CCC works with an increasingly large network of industries, small and medium-sized companies, universities and other knowledge institutes and scientists. Together we are the CCC network: working together in CCC programs, meeting during reviews and symposia. All our partners are mentioned on our website: www.cccresearch.nl.

OUR FUTURE

CCC intends to collaborate with all Dutch universities. Furthermore, we wish to reinforce the international position of Dutch knowledge institutes regarding carbohydrate research. In addition, we will expand our network to become a European knowledge network for top carbohydrate research, working closely with networks abroad and leading universities and industries. Finally, we will make every effort to valorize new knowledge within our consortia.



Elaine Vaughn, Sensus:

'All in all, the program delivered interesting results that gave us at Sensus more insights in the mechanisms of our chicory root fibre ingredients on health. Working on this project together with the academics was very enjoyable and we all learned from one another. That is why we decided to join CarboKinetics.'

Arjan Nauta, FrieslandCampina:

'FrieslandCampina also participates in CarboBiotics. This program is very important. We sometimes need antibiotics, but also know that antibiotics have a negative impact on the beneficial bacteria in our gut. A previous CCC project has shown that GOS intake supports the recovery of beneficial Bifidobacteria after the use of Amoxicillin, a widely used antibiotic. This program, amongst others, continues this research. The program just started, so we are eagerly awaiting the first results.'

HOW WE WORK

CCC is an open organization, welcoming new partners who wish to share their knowledge within our network and have the drive to innovate in areas related to carbohydrates. Partners can both become a member of our CCC network and participate in our research.



SCIENCE AND INDUSTRY

All CCC programs are demand-driven: they all start with a dialogue between CCC and the industry. Once it is clear which fundamental knowledge potential industrial partners are looking for to realise innovations, a program is drawn up. All participants contribute financially to the program: the industry pays 50% and government funding, for instance NWO, invests another 50%. It is important to stress that the research is fundamental and independent: that is why the CCC board coordinates all programs.



PRIVATE-PUBLIC COLLABORATION

CCC is a perfect example of private-public collaboration. We facilitate joint meetings every six months, to update our partners on the scientific progress. Depending on the kind of program, partners may also contribute facilities, data or ingredients. In between the regular meetings, contact between CCC, the scientists and the partners is frequent. Sometimes scientists carry out part of their work on the location of one of the partners. For their part, the industrial partners follow the progress critically. The results so far are promising: the various programs have already led to several patent applications.



Marco van den Berg, DSM:

'The added value for us is that we can jointly benefit from the knowledge, ideas and creativity of academic researchers.'

Paul de Vos, University Medical Center Groningen:

'One of the strengths of CCC is that as a scientist you get to work closely with industrial partners. This leads to great projects and knowledge that is shared widely beyond academia.'

WHY CARBOHYDRATES MATTER

Carbohydrates are essential building blocks of nature: plants, animals, and humans cannot thrive without carbohydrates in the form of fibers and sugars. They provide sturdiness, energy, and food reserves. Carbohydrates are also expected to play a major role in realising a biobased economy: they can be turned into building blocks of for instance bioplastic or used to make high tech products. That is why carbohydrates matter and why it is so important to find out more about them.



OPPORTUNITIES FOR INDUSTRIAL PARTNERS

CCC offers industrial partners the opportunity to contribute to the research into the diverse world of carbohydrates. Together we can unlock new knowledge about their use and application. Together we can contribute to the progress towards targets set for top sectors in which the Netherlands is a global leader, particularly AgroFood, Chemistry and Biobased Economy. Our collaboration leads to a win-win situation: our joint programs lead to breakthroughs in science and provide the industry new information leading to promising innovation.

CAREER OPPORTUNITIES FOR YOUNG SCIENTISTS

For young scientists, our programs offer wonderful career opportunities. They get to work on fundamental research in collaboration with our industrial partners. As a PhD student or post-doc, young scientists get the chance to climb the academic ladder as well as gain valuable experience working with industrial partners. Our multidisciplinary approach also means that they learn more about other areas of expertise than their own and have the chance to expand their personal network significantly.



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• **Are you interested in more information about CCC, our
network and achievements? Do not hesitate to contact us!**

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CCC & INDUSTRIAL PARTNERS

Carbohydrate research is rapidly becoming more interesting for an increasing number of industries. Especially for industries in AgroFood, Chemistry and Biobased Economy carbohydrate research turns out to be very interesting.

Why the Carbohydrate Competence Center is an attractive business partner for these industries:

- Investing in carbohydrate research means opening international opportunities in socially relevant sectors, such as Healthy Ageing and Biobased Economy.
- Application of CCC knowledge strengthens the leadership and competitive power of the Dutch AgroFood industry worldwide and specifically for industries processing sugars, starch, dairy, carbohydrate-rich raw materials and foods.

How CCC demonstrates the value of the private-public collaboration between science and industries:

- Previous and current CCC research programs contribute to the utilization of the value potential of raw materials and residues along the whole carbohydrate value chain, from biomass to food and non-food.
- CCC research is also involved in the refinery of raw materials in order to provide carbohydrates for food and non-food applications.
- Thirdly, CCC contributes to the aim to reduce our CO₂ footprint worldwide by the full utilization of agricultural materials in a sustainable way.

In what way becoming a CCC network partner will boost your own goals as an industry:

- You can join one of our research programs as a partner, generating new knowledge and boosting innovation.
- Partnership means sharing knowledge as well as finances on an equal footing. In addition, we are supported by (inter)national and regional science and innovation subsidy programs. All our programs are collaborations of industrial and academic partners.
- The research is positioned in the precompetitive stage which leads to creative, new ideas without any risk to limit future business opportunities.



WOULD YOU LIKE TO KNOW MORE?

On our website you can find more information about CCC, our partners and our programs. If you like, you can subscribe to our newsletter by submitting your e-mail address. Don't hesitate to contact us and become a member of the CCC network!

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JOIN CCC FOR FUNDAMENTAL AND PRECOMPETITIVE CARBOHYDRATE RESEARCH

At the heart of CCC, two universities have joined forces to boost fundamental, precompetitive research in the field of carbohydrates. The University of Groningen and Wageningen University & Research jointly lead CCC and work closely with other knowledge institutes on excellent demand-driven research.

In ten years we have set up and completed four major research programs, working in private-public collaboration, involving universities as well as industrial partners. At the moment three new programs are underway. All our programs focus on socially important themes like Health & Nutrition and Biobased Economy. Knowledge institutes are invited to take part in these programs, for instance by supplying valuable data sets or by taking part in one or more research projects. An increasing number of institutes have joined our network.

In order to boost sharing new ideas and knowledge, CCC also sponsors meetings and symposia on specific themes, for example, the international, biennial Summer Course Glycosciences and the

Starch Round Table. Twice a year we also organize a symposium where we present the results of the various research projects, giving our PhD students and post-docs the floor. These activities also encourage CCC network members to meet in person, sharing new ideas and knowledge.

The research we carry out is both fundamental and precompetitive, usually leading to new knowledge and boosting innovation. Our PhD students and post-doc researchers get the opportunity to further their academic career as well as the chance to work with professionals employed by our industrial partners. This way, they gain valuable experience, often leading to interesting career opportunities. Over the years, quite a lot of our young researchers have found a job with one of our industrial partners.

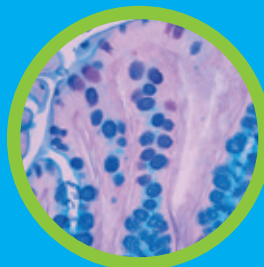


: Don't hesitate to contact us and become a member of the CCC network! We cordially invite universities and knowledge centers to take part in our network. On our website, you can find more information about CCC, our partners, and our programs. If you like, you can subscribe to our newsletter by submitting your e-mail address.

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CCC PROGRAMS AIMED AT HEALTH AND NUTRITION

One of CCC's key areas concerns Health and Nutrition. The fundamental research carried out in this field concerns the synthesis, modification, and/or breakdown of carbohydrates. Within CCC, industrial partners work with knowledge institutes to develop instruments for creating new, carbohydrate-based products and processes.

THE FIRST SUCCESSFUL PROGRAMS

The first program, CCC1, ran from 2009 to 2013, and addressed the topics 'Carbohydrates for Nutrition and Health' and 'Carbohydrate Conversion and Processing'. The program eventually led to the

development of successful new applications and high-grade products, such as new or improved carbohydrate fibres and slow-digesting carbohydrates for healthier diets. CCC2 ran from 2011 to 2014 and continued this work, resulting in for instance

new knowledge on carbohydrate fibres and the acceleration of the potato breeding process. A third program, CCC ABC, running from 2013 to 2018, also touched upon the health and nutrition theme, concerning animal nutrition and starch in particular.

CARBOHEALTH

From 2013 to 2017, CCC coordinated CarboHealth, aimed at the study of carbohydrates that benefit health. The participants focused on an integral and coordinated analysis and identification of beneficial effects of oligosaccharides and polysaccharides on health. The industrial partners contributed to the program by providing funds, carbohydrates and bacterial strains and also by generating ideas and insights, matching the demand-driven approach of CCC.

CARBOKINETICS

CCC NWO CarboKinetics is a research program undertaken by CCC and the Dutch Organization

for Scientific Research (NWO) as part of the NWO CCC Partnership. The research is directed at the improvement of health based on a better knowledge of the utilization kinetics of carbohydrates in the gut. The work of this program focuses on unlocking knowledge which hopefully leads to a better and healthier diet for humans and animals. The program runs from 2016 till 2020.

CARBOBIOTICS

Early 2018, CarboBiotics kicked off as the second NWO CCC program and focuses on reducing the need for antibiotics by fundamental research into the effects of prebiotics and probiotics on stability and recovery of microbiota in the gastrointestinal tract. This will hopefully lead to a better understanding of prebiotic carbohydrates and to the identification and development of new prebiotics and probiotics. The ultimate aim of this program is to generate an efficient pipeline of accurate methods of research.

WOULD YOU LIKE TO KNOW MORE?

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CCC PROGRAMS AIMED AT THE BIOBASED ECONOMY

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CCC has several programs aimed at Biobased Economy and a more sustainable society, next to Health and Nutrition. Carbohydrates from various renewable sources, like potatoes and sugarbeets, are expected to become very important in this field.

CARBOBASED

In 2018 the province of Groningen and industrial partners funded the program CarboBased. This program runs up to 2022. Research is focused on the creation of new biobased products and materials from biomass carbohydrates, retaining the basic carbohydrate structure. In addition, the program focuses on building blocks for new products and materials.

Previous programs already touched on the significance of carbohydrates for the biobased economy, for instance by research into the creation of polymers from biomass like beet pulp. CCC2 resulted in new applications for traditional raw materials such as upgrading and utilization of biobased materials. This included optimization and increasing the added value of potato starch derived materials for use in the paper industry.



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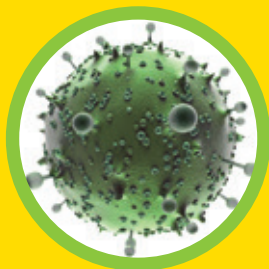
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BECOMING A MEMBER OF THE CCC NETWORK

Becoming a member of the CCC network has quite a few advantages for industries, for knowledge institutes and scientists and for anyone interested in how carbohydrates can be applied in health and nutrition and a biobased economy.

CCC's strong points

- CCC forms a demand-driven, private-public partnership offering high quality research institutions and industrial partners and small and medium-sized companies the opportunity to meet, share and develop new knowledge and promote innovation in the field of carbohydrates.
- CCC provides an excellent starting point for a leading role of the Netherlands in marketing carbohydrate products for a healthier and

sustainable society, in the biobased economy.

- CCC contributes to major social themes, like health & nutrition and biobased & circular economy.
- CCC ensures the commitment of all partners by sharing costs and benefits.
- CCC promotes research that is precompetitive: this means that industrial partners feel free to participate.
- CCC has over ten years of experience with bringing together knowledge centers and industry, combining fundamental research with market-oriented innovation, leading to new products, processes, and jobs.

- CCC offers young scientists the opportunity to carry out fundamental research and gain valuable experience in a stimulating environment, working with top of the bill scientists and industrial professionals.
- CCC stimulates the growth of an international carbohydrate research network of scientific and industrial partners in the Netherlands and in Europa by facilitating and promoting connections between partners.



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