

Associate or full professor in Host-Microbe Biology

Name: Host-Microbe Interactions

Appointment: 1.0 fte

Level: Associate Professor – Full Professor

1. Field of research

The envisioned professorship investigates beneficial interactions between bacteria (commensals) and their mammalian hosts and/or between pathogens and their host. The envisioned research group combines expertise in areas such as cell biology, immunology, microbiology, functional genomics, glycomics (incl. structure and function relationships of carbohydrates) and systems biology to further our understanding of the molecular interactions occurring in the cross-talk between microbes and their mammalian hosts.

2. Vacancy

The vacancy is in the emerging field of Host-Microbe Biology. The candidate complements the expertise in Groningen and elsewhere in the Netherlands on the microbiology of host-microbe interactions. The position has been approved by both the Faculty board (EMK/gl/15/01054) and the University Board as part of the university's investment agenda of 2015.

3. Selection committee

- Prof. dr. Bert Poolman (Scientific Director GBB), chair
- Prof. dr. Lubbert Dijkhuizen (Head research group Microbial Physiology)
- Prof. dr. Ida van der Klei (Head research group Molecular Cell Biology)
- Prof. dr. Willem de Vos (Head of the Laboratory of Microbiology at Wageningen and Academy Professor of Finland at Helsinki University)
- Dr. Sahar El Aidy (RFF Assistant professor at GBB)
- Prof. dr. Ciska Wijmenga (Head research group Systems Genetics; UMCG)
- Mr. Marten Chaillet (Student member)

Additional (external) advisors:

- Prof. dr. Annick Mercenier (University of Strassbourg)
- Prof. dr. Michiel Kleerebezem (Wageningen University)
- Prof. dr. Paul de Vos (University Medical Centre Groningen)
- Prof. dr. Dusko Ehrlich (Director Host-Microbiome Centre; Kings College, UK)
- Mrs. Yvonne Folkers (Human Resources, FMNS)
- Dr. Engel G. Vrieling (Managing Director of GBB), secretary

4. Research area

The interactions between an (animal) host and its microbes are of eminent importance for the wellbeing of the host. For instance, man cannot live without the microorganisms that reside in the gastro-intestinal tract (GIT). The GIT – as well as other cavities/niches of the host that encompass microbiota – in effect can be considered in a simplistic way as a bioreactor breaking down food (or tissue) to deliver energy and nutrients. In reality, however, it concerns complex molecular interactions between the host and microbiome with concerted processes that yet are poorly understood. The interactions between the host and its GIT microbial community can be seen as the communication between the host and the microbial genomes and as a coupling between different physiological capabilities. At the

same time certain microorganisms may pose a significant threat to the health of the host, either directly through pathogenic infections or more indirectly, by interfering with the beneficial host-microbe interactions such as use of antibiotics.

Knowledge is currently emerging on the attributes of the microbes required for beneficial interactions as well as on how to possibly stimulate these interactions via the diet via e.g. non-digestible food components (prebiotic compounds; typically certain carbohydrates) that are selectively fermented by beneficial members of the GIT microbiome. Also, detailed information on the relationship between the GIT microbiome and disease is emerging and with that a surge of interest in manipulating/steering the composition of human GIT community, for instance by supplying (prebiotic) carbohydrates to food and feed. The principles that govern the dynamics and function of microbial communities are still elusive and a thorough analysis of the molecular details of the interactions between beneficial as well as pathogenic microorganisms and mammalian cells is required.

5. Research group and institute

The position will be embedded in the Groningen Biomolecular Sciences and Biotechnology Institute (GBB) of the Faculty of Mathematics and Natural Sciences (FMNS), University of Groningen. The institute GBB has 13 research groups, targeting biological questions in the two focal areas 'Molecular Mechanisms of Biological Processes' and 'Physiology and Systems Biology'. It is foreseen that the candidate for this position will become head of the research group Host-Microbe Biology, succeeding Prof. dr. Lubbert Dijkhuizen who leads the current research group Microbial Physiology, in which Dr. Sahar El Aidy has recently been appointed as Rosalind Franklin Fellow. The research of the chair in Host-Microbe Biology relates to the GBB research activities in microbial systems biology (e.g. Profs. Kok, Kuipers, Heinemann), carbohydrates (e.g. Prof. dr. Dijkhuizen, and Drs. Thunnissen, and Lammerts van Bueren), and antibiotics (e.g. Profs. Driessen, Veening, Kuipers). Carbohydrate research is an important focus in the Microbial Physiology group and as such strongly contributes to the public-private partnership program "Carbohydrate Competence Centre" that is directed by Prof. dr. Dijkhuizen. The envisioned research also directly contributes to activities in the FMNS theme Molecular Life & Health, in particular the research on new antimicrobials and antibiotic resistance, and the theme Adaptive Life. It further adds to the ambitions of the European Research Institute for the Biology of Ageing (ERIBA) and the spearhead Healthy Ageing of the University of Groningen.

6. Local and (inter)national position

Current state in the Netherlands: Research on various aspects of the interactions among the GIT- and pathogenic microbial communities and of those communities with the (human) host is performed at different universities and medical centres in the Netherlands, including the University of Groningen and the University Medical Centre Groningen (UMCG).

At the Groningen Biomolecular Sciences and Biotechnology Institute (GBB), Prof. Lubbert Dijkhuizen and co-workers focus on the enzymatic synthesis and degradation of probiotic carbohydrates. In the same GBB research group, Dr. Sahar El Aidy aims to unravel the mechanisms and function of microbial neurochemicals in the gut microbiota-host dialogue. Prof. Jan Willem Veening at GBB studies the persistence and virulence of *Streptococcus pneumoniae* related to their pathogenicity in the nasal cavity. At UMCG, Prof. dr. Paul de Vos investigates the role of gut microbiota composition on metabolism and cardiovascular disease, and Prof. dr. Jan-Maarten van Dijk addresses the dynamics of the human gut microbiota and the interactions between bacteria, not only in relation to disease but also in response to interventions with antibiotics or prebiotics and probiotics.

At Wageningen University, Prof. dr. Jeremy Wells and Prof. dr. Michiel Kleerebezem both focus on innate defence mechanisms in the small intestine, probiotic interactions with dendritic cells, and virulence factors of *Streptococcus suis* and disease pathogenesis. Jointly between Wageningen University and Helsinki University, Prof. dr. Willem de Vos aims at a fundamental understanding of the diversity/function of GIT microbes, with a focus on mucus-binding bacteria that are either indigenous or ingested as part of the diet. Generally, 'omics' technologies, including high-throughput functional (meta)genomics approaches, and systems biology are used to investigate host-microbe interactions. Other relevant studies on host-microbe interactions different from the GIT are pursued for instance at: i) UMC Utrecht (Prof. Jos van Strijp), regarding the question on how bacteria escape the immune system, ii) the Amsterdam Institute for Molecules, Medicines and Systems (Prof. Willem Bitter), addressing mycobacterial virulence, and iii) Erasmus University Rotterdam (Prof. Willem van Wamel), targeting host-pathogen interactions.

International: Several (recent) initiatives exist on research of the human (GIT) microbiome, underpinning the importance of the field. Examples are:

- *MetaGenoPolis (MGP), France.* A demonstration project funded by the French initiative Investissement d'avenir, aiming at establishing the impact of the human gut microbiota on health and disease. MGP integrates the technology and the expertise to explore this complex field of research. Major research themes are nutrition and medical interventions.
- *NGBI - Örebro University, Sweden.* The Nutrition-Gut-Brain Interactions program was established in 2012 as a multidisciplinary research- and innovation center. Major questions are related to how (e.g. by diet or administration of pre- and probiotics), when and in whom gut function can be improved by modification of diet and/or composition of the intestinal microbiota. Specific focus is on common intestinal disorders such as irritable and inflammatory bowel syndrome, and decreased gut function associated with ageing.
- *The NIH Human Microbiome Project* is one of several international efforts designed to take advantage of large-scale, high-throughput multi-omics analyses to study the microbiome in human health.
- *Genome Institute of Singapore (GIS) and Nutricia Research NL* (Prof. dr. Jan Knol) investigate the health benefits of prebiotics, probiotics and synbiotics and seek to understand how nutrition supports microbiome in early life and can help prevent disease later in life.

7. Expected contribution to research

The research tasks entail (i) fundamental scientific studies that result in publications of high impact, appearing in internationally renowned scientific journals, and (ii) the supervision of PhD students and postdoctoral fellows in their research. External fund raising is essential to accomplish the aforementioned tasks. The research activities should further result in the strengthening of the international position of GBB in (microbial) physiology and systems biology in general.

8. Expected contribution to teaching

The successful candidate organizes and presents lectures as well as hands-on practicals to students at both the BSc and MSc levels. He/she also supervises (under)graduate students during BSc/MSc research and thesis projects. The educational tasks comprise predominantly the development of courses and teaching on host-microbe biology such as the molecular aspects of the (GIT) microbiome and the role of the microbiome in human

health and nutrition. These topics fit perfectly in the current curriculum of the majors Molecular Life Sciences, Biomedical Sciences, Behavioural and Neurosciences at the bachelor level and the ensuing respective Masters' programs. Host-Microbe Biology is also of eminent importance in the new curriculum of FMNS and FMS on 'Food and Nutrition'.

9. Expected contribution to the organisation

It is expected that the candidate will play an active role in the general organization of research at national and international levels and within the research group Microbial Physiology, the institute GBB, the Carbohydrate Competence Center (CCC), and overarching activities within the faculty theme Molecular Life and Health.

10. Career perspective

The position will be offered at the level of Associate or Full Professor. Promotion to a next level proceeds according to the document 'Career Paths in the Sciences' of the FMNS. The offered position will be filled according to the actual University Function Ordering (UFO) system and regulations defined by the Union of Dutch Universities (VSNU). The following applies for:

- Associate Professor: An adjunct professor has *ius promovendi*, i.e. the legal right to formally complete the supervision of PhD students. After 4-7 years the associate professor may apply for a promotion to full professor.
- Full Professor: this includes *ius promovendi*.