2019 Helmholtz – OCPC – Program
for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project: Health effects of endotoxin (LPS) from ambient outdoor air

Helmholtz Centre and institute: Helmhotzzentrum München, Germany

Project leader:
Prof. Dr. J. Buters (receiving and paying party),
additional support by Prof. Dr. Schloter (comparatice microbiome analysis)

Web-address: www.zaum-online.de and https://www.helmholtz-muenchen.de/comi/index.html

Description of the project (max. 1 page)**:**

The project focusses on the interaction of bacteria (endotoxin) from airborne pollen, and allergies affecting the human immune system.

LPS is marker for Gram-negative bacteria and is an important immunogenic compound. **Endotoxin** is also detected in ambient air and as such important in respiratory immunologic diseases like **allergies** and asthma, both diseases of the respiratory system. We discovered the main source of outdoor ambient endotoxin: **airborne pollen** from the plant species *Artemisia vulgaris*. This pollen explains up to 70% of the yearly exposure to LPS from outdoor air. The bacteria on this pollen were identified by sequencing and belonged mainly to *Pseudomonas* and *Panthoea* spp., i.e. the microbiome on this pollen was not random.

About 1 in 4 Germans suffer from an allergic disease, mostly hay fever, and the dominant causative agent is pollen. In **China**, depending on the region, pollen from Artemisia are the main airborne pollen allergen resulting in many Artemisia allergic individuals in China. This disease has a substantial burden of disease and due to the large number of patients, evokes high economic costs. Additionally, about 30% of allergic rhinitis patients become asthmatic, which can be life threatening. In Bavaria about €600 Mio/year is spend on allergic diseases, and due to the increasing trend in allergic sensitizations their importance is expected to rise.

To become allergic, exposure to an allergen is needed, in conjunction with a “danger signal” like endotoxin. We could show that without this build in danger signal (endotoxin) on these pollen, the pollen was harmless. Our work on endotoxin on pollen recently won a price from the German Allergy Society 2018 (1).

Endotoxin is known to be a protective agent for allergic disease i.e. exposure to many bacteria is protective for allergy (hygiene hypothesis). Endotoxin is not one molecule, but a group of very divers molecules and its structure depends on its bacterial source. We showed that endotoxin is not always protective. This put forward the question, if some endotoxins have a detrimental effect, and other a beneficial effect on the immune system. The concept of "good" and "bad" endotoxin is new in immunology and not (yet) widely accepted.

In this project we want to examine two aspects of airborne endotoxins:

1. Do "good" and "bad" endotoxin exist and which bacteria produces which endotoxin. Here bacterial work, isolation from natural pollen sources, characterization with extensive analytical methods and biological methods, and showing their relevance in allergy models (currently also mouse models).
2. What is the mechanism why and how certain bacteria preferentially use Artemisia pollen as their "taxi". This includes the determination of presence of resistance to antimicrobial agents (MRSA) in bacteria on pollen.

The work is a joint effort between two PI (principal investigators), one specialized in pollen and allergic disease (Buters) and one specialized in bacterial characterization (Schloter). The "allergic" work will be mainly done one lab, the "bacterial" work in the other lab.

We offer an innovative topic which large medical consequences i.e. future career possibilities. Both groups are internationally well accepted as experts in their field. The candidate needs to bridge the problems from collection of samples (worldwide) up to detailed analytical and sequencing analysis of the samples.

Literature

1. Oteros, J., Bartusel, E., Alessandrini, F., Nunez, A., Moreno, D., Behrendt, H., Schmidt-Weber, C., Traidl-Hoffmann, C., and Buters, J. (2018) Artemisia pollen is the main vector for airborne endotoxin. *J Allergy Clin Immunol*

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

Required qualification of the post-doc:

- PhD in biology
- Experience with either microbiome or pollen or air pollution or a combination
- Additional rudimentary skills in R-or Python programming
- Interest in laboratory experiments