

Letter of Intent: Postdoctoral Researcher in Molecular Microbiology & Microbial Metabolism

Dear Selection Committee,

I am writing to express my strong interest in the Postdoctoral Researcher position in Molecular Microbiology & Microbial Metabolism at ETH Zurich. With my extensive background in gut microbial biotechnology and my passion for understanding complex microbial ecosystems, I am excited about the opportunity to contribute to your groundbreaking research at the interface of foods and human health.

RESEARCH BACKGROUND AND INTERESTS

My fascination with the microbial world has been a driving force throughout my academic career. From studying single nucleotide polymorphisms in major foodborne pathogens during my master's research project to delving deep into gut microbial biotechnology for my PhD, I have developed a profound interest in understanding microbes in food systems and their impact on human health. My doctoral research in the Laboratory of Food Biotechnology of ETH Zurich, focused on "The Effect of Exogenous and Endogenous Vitamin B9 and B12 on Microbial Growth and Metabolism in the Human Gut," has provided me with a strong foundation and understanding in microbial metabolism. This work has given me hands-on experience with many of the techniques and approaches outlined in the job description:

- **Microbial Cultivation:** I have extensive experience in developing and utilizing *in vitro* cultivation methods for studying microbial metabolism, including work with anaerobic batch fermentations and *in vitro* models of the human colon.
- **Analytical Techniques:** During my doctoral research, I developed a UHPLC-UV/MS analytical method for identification of novel analogues of vitamin B12 produced by notable human gut microbes. Moreover, I utilized HPLC-RI for metabolite profiling and frequently employed GC-MS based methods to understand gas production by gut microbes in response to the applied treatments during my research. On a side note, I also used MS based methods during my bachelor studies research project to identify soymilk proteins as an adulterant in milk.
- **DNA Sequencing and Bioinformatics:** My work involved both 16S rRNA marker-gene sequencing and metagenomic analysis. I have experience with bioinformatics tools for microbiome data analysis. Recently, I also completed an RNA-seq analysis workshop using the Galaxy platform, further expanding my bioinformatics skillset.

RESEARCH VISION AND PROPOSED AIMS

The focus of your project on the interaction between gut microbes and food contact chemicals is fascinating and aligns closely with my research interests. I believe it will be a challenging project, and building on my experience, I propose the following research aims:

1. **In Vitro Modeling of Chemical-Microbiome Interactions:** As a first step, I propose to utilize and develop high-throughput *in vitro* models of the human colon to study the dynamic interactions between food contact chemicals (FCCs) such as surfactants, N-ring containing substances, and nanoparticles, and the gut microbiome. This would include analyzing changes in microbial community composition and metabolic outputs in response to different FCCs. My experience with anaerobic batch fermentations and *in vitro* colon models will be valuable in this aim.
2. **Characterization of Microbial Biotransformations:** Following the *in vitro* modeling, I aim to develop a high-throughput screening method to identify and characterize microbial enzymes involved in the biotransformation of FCCs. This would involve using LC-MS/MS to detect metabolites and next-generation sequencing to identify the genes responsible for these

transformations. My expertise in developing UHPLC-UV/MS methods for vitamin B12 analogues will be particularly relevant here.

- 3. Synthetic Biology Approaches:** Building on the findings from the first two aims, I propose to engineer gut microbes to express specific enzymes identified in aim 2. This will allow us to study their potential for detoxifying harmful food contact chemicals or producing beneficial metabolites. While this area represents an exciting opportunity for me to expand my skillset, my strong background in molecular biology will provide a solid foundation for this work.

RELEVANCE OF PAST RESEARCH

My doctoral work and related publications have prepared me well for this position. My research on vitamin B12 production in gut microbiota (Frontiers in Nutrition, 2022) demonstrated the self-sufficiency of healthy adult gut microbial communities in B12 production and the impact of exogenous B12 supplementation on overall protein metabolism. In a follow up study on vitamin B12 analogues and propionate production (Frontiers in Nutrition 2024), I confirmed B12 production in gut bacterial strains and showed that gut microbially produced B12 promotes propionate metabolism in B12 auxotrophic gut bacteria. My work on vitamin B9 production (BMC Microbiology, 2024) quantified B9 production by gut bacteria and investigated its impact on specific gut bacteria and fecal microbial communities. Additionally, I co-authored a comprehensive review on dietary micronutrients in inflammatory bowel diseases (Molecular Nutrition & Food Research, 2021), gaining broad understanding of micronutrient-microbiome-host interactions. Earlier work on genomic changes in foodborne pathogens (Canadian Journal of Microbiology, 2019) improved my skills in whole genome sequencing and bioinformatics analysis. These studies have provided me with expertise in microbial cultivation, analytical techniques (including UHPLC-DAD/MS, HPLC-RI), DNA sequencing, and bioinformatics, all directly applicable to investigating interactions between FCCs and the gut microbiome in this postdoctoral role.

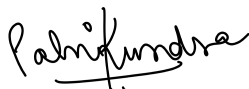
SCIENTIFIC MISSION

My (broad) scientific goal is to use advanced molecular and computational techniques to understand the complex relationships between the gut microbiome, diet, and human health. I am particularly interested in using this understanding to develop new strategies for improving food safety risk assessment and enhancing human health outcomes. In this postdoctoral position, I aim to contribute to our knowledge of how food contact chemicals affect the gut microbiome and explore how microbial biotransformations might reduce any adverse health effects. This research could help shape food safety regulations and may propose new biotic interventions. Beyond conducting research, I am committed to scientific writing and sharing knowledge. I believe that clearly communicating scientific findings is crucial for connecting laboratory discoveries with practical applications such as in food safety and public health. My approach combines thorough scientific investigation with a focus on clear, accessible scientific communication, aiming to increase the impact and reach of our research findings.

I am excited about the opportunity to bring my expertise in microbial metabolism and microbiome analysis to your team, while also expanding my skills in synthetic biology and computational omics.

Thank you for considering my application. I look forward to the possibility of discussing how my background and research vision align with your team's goals.

Sincerely,



Palni Kundra