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.

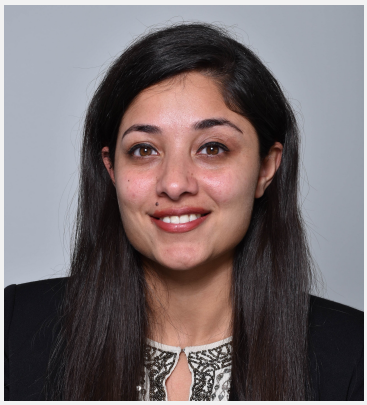
Thank you for considering my application. I look forward to the possibility of discussing how my background and research vision align with your team's goals.

Sincerely,

Palni Kundra

PALNI KUNDRA

Biotechnology, Food Science, Microbiology, Nutrition, Vitamins, Metabolomics



PERSONAL STATEMENT

Driven by scientific curiosity and a commitment to understanding complex microbial systems, I bring over 7 years of research and scientific writing experience, along with a Ph.D. in gut microbial biotechnology from ETH Zurich, to explore broader microbial ecology research. With a multidisciplinary background in food science, microbiology, and biotechnology, I excel in protocol development, conducting complex biological studies, with extensive hands-on experience in molecular and analytical techniques.

KEY COMPETENCIES

- Possess in-depth knowledge across various scientific disciplines, including food science, microbiology, nutrition, gastroenterology, probiotics, biotechnology and biology.
- Proficient in translating complex scientific concepts into clear, engaging content, as well as translating scientific findings into actionable next steps.
- Proficient in designing, implementing, and executing research projects, encompassing laboratory techniques, statistics and bioinformatics.
- Proven ability to collaborate effectively with internal and external teams.

EDUCATION

2018 | 2023

ETH Zurich
Doctorate (Ph.D., Dr. sc.) — Zurich, Switzerland
Supervisor: Prof. Dr. Christophe Lacroix

2016 | 2018

McGill University
Masters of Science (M.Sc.) — Montréal, Canada
Supervisor: Prof. Jennifer Ronholm
CGPA: 3.87/ 4

2011 | 2015

Guru Nanak Dev University
Bachelor of Food Science and Technology — Amritsar, India
Advisor: Prof. Bhartendu Singla
CGPA: 8.7/ 10 (*Gold medalist*)

WORK AND RESEARCH EXPERIENCE

Sep 2018 | Jun 2023

Scientific Assistant
ETH Zurich — Zurich, Switzerland

- **Supervisor:** Prof. Dr. Christophe Lacroix
- Completed a multi-year research project investigating the modulatory potential of dietary and gut-microbially produced vitamin B9 and B12 on the complex gut microbiota, as well as on single next generation probiotic gut microbes.
- Led the planning and execution of laboratory experiments, developed experimental and analytical methods (UHPLC-UV/MS), and analyzed metagenomic and other data types.
- Completed project deliverables by preparing research findings for publication in scientific journals.
- Presented research findings at scientific conferences, effectively communicating complex scientific concepts to diverse audiences.
- Mentored Bachelor's and Master's students throughout their thesis projects, and facilitated a semester laboratory course, enhancing hands-on learning experiences.

AWARDS AND MEDALS

Gold medal (Bachelor Studies)
University topper 2015

Poster presentation award
Second prize, Green tea ice cream
Presented at science exhibition
2015

COMPUTATIONAL SKILLS

Bioinformatics skills: metagenomic data analysis
Programming: R, Bash
Version control: git
Project management: GitHub

LANGUAGES

English (Native, C1)
German (Written A2, spoken B1)
Hindi (Native)
Punjabi (Native)

CONTACT INFO

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MORE INFO

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pkundra

May-Sep 2017

Graduate research project
McGill University — Montréal, Canada
- **Supervisor:** Prof. Jennifer Ronholm
- Conducted whole-genome SNP-based analysis to identify changes under laboratory conditions in major foodborne pathogens responsible for global outbreaks.
- Provided support for preparing the manuscript for publication.

Jan-Feb 2015

Student research assistant
Guru Nanak Dev University — Amritsar, India
- **Supervisor:** Prof. Pankaj Gupta
- Developed an innovative food product - Green tea ice cream.
- Performed sensory and organoleptic evaluation.
- Presented the product at scientific conference.

Jul 2014 | Mar 2015

Student research assistant
Guru Nanak Dev University — Amritsar, India
- **Supervisor:** Prof. Bhartendu Singla
- Developed various innovative soy-based food products to enhance gluten-free product.

May-Jun 2013

Research internship
Indian Council of Agricultural Research — Ludhiana, India
- **Supervisor:** Dr. Pranita Jaiswal
- Applied a non-destructive quality control approach to a develop spectrophotometeric method for the detection of Soy-milk adulteration in cow milk.
- Performed spectrophotometer analysis.

Jun 2013 & Jul 2014

Industrial internship
Markfed Canneries — Jalandhar, India
- Performed microbiological testing and applied quality control assurance techniques.

Jun-Jul 2013

Industrial internship
Verka Milk plant — Jalandhar, India
- Performed microbiological testing and applied quality control assurance techniques.

SCIENTIFIC PUBLICATIONS

Peer-reviewed Publications

Palni Kundra, Annelies Geirnaert, Benoit Pugin, Serafina Plüss, Susanna Kariluoto, Christophe Lacroix, Anna Greppi. Microbially-produced folate forms support the growth of Roseburia intestinalis but not its competitive fitness in fecal batch fermentations. **2024**. *BMC microbiology*. doi: 10.1186/s12866-024-03528-6

Palni Kundra, Anna Greppi, Monica Duppenthaler, Serafina Plüss, Benoit Pugin, Christophe Lacroix, Annelies Geirnaert. Vitamin B12 analogues from gut microbes and diet differentially impact commensal propionate producers of the human gut. **2024**. *Frontiers in Nutrition*. doi: 10.3389/fnut.2024.1360199

Palni Kundra, Annelies Geirnaert, Benoit Pugin, Paola Morales Martinez, Christophe Lacroix, Anna Greppi. Healthy adult gut microbiota sustains its own vitamin B12 requirement in an in vitro batch fermentation model. **2022**. *Frontiers in Nutrition*. doi: 10.3389/fnut.2022.1070155

Palni Kundra, Carole Rachmühl, Christophe Lacroix, Annelies Geirnaert. Role of dietary micronutrients on gut microbial dysbiosis and modulation in inflammatory bowel disease. **2021**. *Molecular Nutrition & Food Research*. doi: 10.1002/mnfr.201901271

Nicholas Petronella, **Palni Kundra**, Olivia Auclair, Karine Hébert, Mary Rao, Kyle Kingsley, Katrien De Bruyne, Swapan Banerjee, Alexander Gill, Franco Pagotto, Sandeep Tamber, Jennifer Ronholm. Changes detected in the genome sequences of Escherichia coli, Listeria monocytogenes, Vibrio parahaemolyticus, and Salmonella enterica after serial subculturing. **2019**. *Canadian Journal of Microbiology*. doi: 10.1139/cjm-2019-0235

THESES

Jun 2023 — **Doctor of Sciences**
Palni Kundra, 2023. Dr. sc. Thesis. The effect of exogenous and endogenous vitamin B9 and B12 on microbial growth and metabolism in the human gut. doi: 10.3929/ethz-b-000641198

Jan 2018 — **Master of Science**
Palni Kundra, 2018. M.Sc. Research project. Single Nucleotide Polymorphisms in major food-borne pathogens.

MENTORING

Master projects at ETH Zurich

Monica Duppenthaler Vitamin B9 and B12 driven trophic interactions in the human gut. *Master in Food Science*. Jul 2021 - Jan 2022 (Thesis)

Janik Mutter Vitamin B9 production and cross feeding among human gut microbial strains. *Master in Biology*. Mar 2021 - Jul 2021 (Research project)

Bachelor thesis projects at ETH Zurich

Sabina Galli B-vitamin bio-factory in the gut: In-vitro vitamin B9 production and utilization by human gut microbes. *Bachelor in Food Science*. Jul 2022 - Oct 2022

Sara De Crescenzo In-vitro Vitamin B12 Production by Human Gut Bacteria. *Bachelor in Food Science*. Jul 2021 - Oct 2021

Giuliano Menegon B-vitamin sharing: In-silico and in-vitro study to determine B9 and B12 cross-feeding between human gut microbial strains. *Bachelor in Food Science*. Jun 2020 - Nov 2020

Lucie Kuhn Give them vitamins: Impact of B9 and B12 on the acetate and butyrate production on human gut microbes. *Bachelor in Food Science*. Nov 2019 - Feb 2020

Blandine Genet Give them vitamins: Impact of B9 and B12 on the butyrate and propionate production on human gut microbes. *Bachelor in Food Science*. Jun 2019 - Sep 2019

TEACHING

2019 - 2022 — **752-5004-00L: Food Biotechnology Laboratory Course** — Semester course
ETH Zurich — Zurich, Switzerland
Main responsible for cheese practical (2019 & 2020) and sour dough bread practical (2021 & 2022).

ORAL AND POSTER PRESENTATIONS

Sep 2021 — **Human Gut Microbial Strains Produce Vitamin B12** — Oral & Poster
6th International Vitamin Conference — Denmark

Jul 2021 — **In-Vitro Vitamin B12 Production by Human Gut Microbial Strains** — Poster
ANAEROBE 2021: THE MICROBIOTA AND BEYOND — Online

Feb 2015 — **Development of soy-based product and their organoleptic evaluation** — Poster
Advances in agricultural Science & biotechnology, *DAV College Jalandhar* — India

Jan 2015 — **“Green tea ice cream”** — Poster
Science exhibition, *DAV College Jalandhar* — India

WORKSHOPS/ COURSES (NOT ON TRANSCRIPTS)

2024 **Interpretation and Application of ICH E6(R2) by Multi-Regional Clinical Trails (MRCT)**
The MRCT Center of Brigham and Women's Hospital and Harvard (Online), Switzerland

2024 **A practical introduction to bioinformatics and RNA-seq using Galaxy**
Galaxy Training Network (Online), Switzerland
Sequencing, quality control and reference based mapping, Differential gene expression, DESeq2, Bioinformatic and RNA-seq data analysis on Galaxy Platform.

2023 **PMDA Summer School**
Roche Basel, Switzerland
Predictive modelling and data analytics summer school to solve problems in drug discovery and development.

2022 **Project Management for research – for doctoral students**
ETH Zurich Zurich, Switzerland
Project risk management, project management.

2021 **Scientific poster design**
University of Zurich Zurich, Switzerland
content structure, typography do's and don'ts, design principles, design grids, design tools, image editing, perception, color theory.

2021 **Energy and stress management: How to perform in the storm**
University of Zurich Zurich, Switzerland
Energy management, understand obstacles and overcome them, achieve targeted change.

2021 **Time and self management for PhD Candidates**
ETH Zurich Zurich, Switzerland
Assess habits, values, goals, energy, and time management techniques.

2021 **Leadership skills for PhD Candidates**
University of Zurich Zurich, Switzerland
Management, leadership, needs analysis, behavior, destructive leadership, and case studies.

2020 **Statistics for Experimental Research**
ETH Zurich Zurich, Switzerland
Experimental designs, statistical analyses using R, report analyses and results in a scientifically appropriate manner.

2018 **Mass spectrometry-based metabolomics - from theory to practice**
Functional Genomics Center of University and ETH Zurich Zurich, Switzerland
Metabolomics overview, and data analysis and interpretation.

2017 **Introduction to genomic analysis**
Compute Canada & University of British Columbia (Online) Canada
UNIX programming, alignment, Variant calling and annotation, data visualization, and RNA-Seq including statistical analysis.

2014 **36th Post-harvest technology - short course**
University of California, Davis Davis, USA
Advanced Crops handling and harvesting systems.

CONTACT DETAILS OF REFEREES:

1. **Prof. em. Dr. Ing. Christophe Lacroix (PhD thesis Supervisor and PhD Thesis committee)**

   Full professor and group leader at Food Biotechnology group
   Department of Health Science and Technology
   ETH Zurich
   Email: christophe.lacroix@hest.ethz.ch

2. **Dr. Anna Greppi (PhD thesis Co-supervisor and PhD Thesis Committee)**

   Senior Scientist at Food Systems Biotechnology
   Department of Health Science and Technology
   ETH Zurich
   Email: anna.greppi@hest.ethz.ch

3. **Dr. Annelies Geirnaert (PhD thesis Co-supervisor and PhD Thesis Committee)**

   Senior Scientist at Food Biotechnology group
   Department of Health Science and Technology
   ETH Zurich
   Email: annelies.geirnaert@hest.ethz.ch