

Thesis subject: *Biological properties, sanitary safety and nutritional evaluation of a new food strategy approach based on flour insects*

Nowadays, food production, which guarantees an adequate diet, cannot be dissociated from its ecological footprint. Indeed, the way we eat will have to change, due to the depletion of certain resources on the planet, and also due to the degradation of the environment and biodiversity linked to certain agricultural practices and consumption habits.

Among the potentially sustainable solutions, we can cite the development of insect consumption, which may be a particularly promising alternative for feeding the entire population while preserving our environment. Although it is still poorly perceived in France, insect consumption could be an excellent response to the ecological footprint associated with meat production today. Entomophagy (i.e. the consumption of insects) is still in its infancy in Europe, even though environmental and nutritional issues are changing the eating habits of European citizens.

This PhD position proposition is part of the PUNAISES project (Pour Une Nutrition et une Alimentation à base d'Insectes: quelles conséquences Scientifiques, Economiques et Sociales?) which merges different laboratories of the University of Grenoble Alpes which are part of a Federative Research Structure (SFR SIGN, <https://sfr-sign.univ-grenoble-alpes.fr/>)

The *challenge is* to propose a new nutritional approach based on flour insects that is more respectful of the environment **while preserving or even improving the health of the entire population and in particular the most vulnerable (growing, pregnancy, lactation & elderly)**. The chronic use of new foods as this flour insects requires pre-clinical evaluation.

In this project, the PhD student will evaluate:

- the nutritional value and benefit (beyond the nutrient composition, it is their actual bioavailability that must be known, the metabolic benefits....)
- and especially, the sanitary safety in particular the study of the potential bioaccumulative power of insects with respect to toxic substances present in the environment, their capacity to metabolize these substances and their potential allergenic power in order to optimize the production of insects with the aim of ensuring maximum sanitary safety for consumers

These evaluations will be done at different stage of life in particular during pregnancy, lactation, growth and in elderly which are vulnerable population from a nutritional point of view. Indeed, these periods are accompanied by major physiological upheavals requiring adapted nutrition and generating greater fragility.

Through the use of rat models (adults, pregnant or lactating rats, growing and aged rats), we will assess the bioavailability and tissue distribution of different nutrients, and potential accumulated toxic substances and their metabolites. At the same time, we will evaluate, in the same models, the tolerance (max % of the feed that could be replaced by insect flours) and the possible side effects (allergy, contaminants, possible pollutants, impact on the microbiota etc.). Knowing that half of the European population is overweight or obese, we will reproduce these experiments in rat models fed a high fat diet.

The student will work in close collaboration with other people involved in this project who will be in charge of evaluating the nutritional benefits i.e their potential antihypertensive, cardioprotective effects benefit (potentially linked to the fact that insects could be a source of ACE inhibitory peptides (Cito, 2017, Pessina, 2020), body composition, protein-energy metabolism, carbohydrate-lipid metabolism, animal behaviour and motor skills, sports performance (endurance, muscle strength etc.) at all life stages and in obese rat models fed a high fat diet.

In conclusion, this work will allow us to define the conditions of production of these insects allowing to optimize their nutritional properties for general but also vulnerable population while ensuring the sanitary safety of the consumer, by providing in particular data which will allow the determination of maximum residual limits on the toxic substances which can accumulate in the insects.

Laboratories of assignment:

Laboratoire TIMC - CNRS UMR5525

Equipe « Environnement et Prévention en Santé des Populations »

Université Grenoble Alpes

Domaine de La Merci, 38706 La Tronche Cedex

<https://www.timc.fr/>

In close collaboration with Laboratoire Bioénergétique Fondamentale et Appliquée – INSERM 1055

Université Grenoble Alpes

2280 rue de la Piscine, 38400 Saint Martin d'Hères

<https://lbfa.univ-grenoble-alpes.fr/>

Context and work environment**INSTITUTION: Univ. Grenoble Alpes, University of Innovation**

One of the major research-intensive French universities, Univ. Grenoble Alpes enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments. The vibrant ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alpes is an internationally engaged university. A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation. In 2016, Univ. Grenoble Alpes was labeled «Initiative of Excellence ». This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century.

This thesis is a co-supervision. The PhD student will work in two laboratories:

- **The TIMC laboratory** is a laboratory of the University Grenoble Alpes and is also accredited by the French CNRS and the VetAgro Sup School (UMR 5525). This laboratory gathers scientists and clinicians towards the use of biology, computer science and applied mathematics for understanding and controlling normal and pathological processes in biology and healthcare. Within this laboratory composed of 300 statutory staff, the Environment and Prevention of Health Population” team works on the detection, evaluation, understanding and modeling of occupational and environmental health risks in order to optimize their prevention and reduce the incidence of associated pathologies.

More information at: <https://www.timc.fr/>

In this context, the laboratories are seeking an applicant interested in preparing a PhD thesis funded by a 3-year fellowship, **under the affiliation of the doctoral school ISCE.**

- **The Laboratory of Fundamental and Applied Bioenergetics (LBFA)** is a laboratory of the University Grenoble Alpes and is also accredited by the French INSERM (U1055). Its scientific activities are oriented towards the study of the energetic and metabolic homeostasis and their contribution in cellular functions. Within the axis #3 (Nutrition, muscle & healthy living and aging), some research is focused on the impact of nutrition on energy metabolism and more generally on health in particular during fragile periods of life.

More information at: <https://lbfa.univ-grenoble-alpes.fr/>

Team description (N+1 and colleagues):

This project is under the authority of Christine Demeillers, MCU (HDR, 70%) and Karine Couturier, MCU (30%), who will supervise the PhD program. For the implementation of that project, several members of the technical staff would contribute to some of the experiments as well as to granting access and training to the use of technical platforms.

Position's mission and main activities**Mission:**

The person recruited will be in charge of the majority of the experiments described in the main project.

Main activities:

- literature search and review
- experiments planning
- writing of application for administrative authorizations
- experiments:
 - animal experimentation: rat models
 - determination of pesticides and metals by LC-MS/MS and GC-MS/MS
 - biochemical and tissue analysis
 - toxicological parameters
 - toxicokinetics studies
 - proteomics
 - Oral glucose tolerance test or ip insulin tolerance test on animal model
 - histology
 - RNAseq and changes in genes expression
 - functional measures (dynamic endurance and muscle strength in situ...) on animal model
 - analysis of the proteosynthesis/proteolysis balance and their related signaling pathways
- analysis and interpretation of results
- writing of draft for publications and presentation of the results in seminars or to scientific meetings of interest
- some teaching assignments can be also proposed in interested

Restriction or constraints related to the position

This project is mainly based on animal models (rodents). It is recommended to have already worked with animals but all the procedure necessary for the thesis and carried out on the animal can also be learned at the beginning of the thesis. Working during week-end days are also not excluded due to some characteristics in research procedures. Wearing of security and protective individual equipment is mandatory in some areas. Additional formation during the PhD program can be scheduled, funded by the laboratory.

Desired profile

Expected skills (priority):

Strong background in toxicology and metabolism and interest in their fundamental aspects

• **Trade skills/ expertise**

Skillful in basic biochemical analyses and handling animals are a plus but are not mandatory (training will be provided)

Basic skills in statistical analysis of experimental data

• **Personal skills**

Master with a research internship

Interest in the role environment and nutrition on the health

Know-how: Be team-oriented, organized and rigorous, proactive, accountable, writing skills

Desired professional experience : beginner 2 to 5 years

Previous formation, diplomas:

Applicants must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

General information

Contact for the questions related to the position:

First name, LAST NAME, position: Christine Demeilliers, Assistant-professor, christine.demeilliers@univ-grenoble-alpes.fr

Applicants will have to send an application letter in English and attach:

- Their last diploma

- Their CV
- A short presentation of their master degree scientific project (1 to 2 pages max)
- Letters of recommendation are welcome.

SELECTION PROCESS

Application deadline: before **19/05/2023**

You can candidate on the doctoral school ISCE by : <https://adum.fr/as/ed/proposition.pl?site=edisce>

TYPE of CONTRACT: temporary-3 years of doctoral contract

JOB STATUS: Full time

HOURS PER WEEK: 35

OFFER STARTING DATE: **01/11/2023**

APPLICATION DEADLINE: **31/05/2023**

Salary: 2044.12 € gross income per month

Financing of the thesis : IDEX CDP PUNAISE, Doctoral school ISCE