Toulouse Biotechnology Institute
Bio & Chemical Engineering

Internship offer (Research, 6 months, Master 2 or equivalent)

Does it worth including novel ingredients in animal feed formulations? Insights by combining life cycle and uncertainty analysis

Background

The internship position is part of the Cambioscop project, awarded in 2017 to Prof. Lorie Hamelin. Cambioscop's objective is to propose sustainable strategies for shifting towards low fossil carbon use in France, by 2050. This transition requires to make the most of available residual streams, among others. Though the energy sector can be decarbonized, non-fossil carbon sources will still be needed for the chemical, material and food sectors. In this transition, one key source of carbon stems from residual biomass resources (agricultural residues, forest residues, organic waste, etc.). Yet, their use as a carbon feedstock for products and services relying at present on fossil carbon is not de facto sustainable. A key step in Cambiocop is to determine, on the basis of an understanding of the 2020-2050 markets and of France's resources, which residual biomass stream to divert to which technology in order to ensure a competitive, sustainable and tailor-made bioeconomy for France.

In this endeavor, previous works within the team specifically assessed the environmental relevance of formulating novel food and feed ingredients from residual streams, focusing on the processing stage. Such novel ingredients include insects, microbial proteins, leaf extracts, among others. Ongoing work consists in assessing the integration pattern of these novel ingredients in animal feed formulations, based on least-cost optimization algorithms (Python-based). These formulations are based on the price and the biophysical characteristics (such as the nutrient content, specific amino acids, etc.) of novel ingredients, and aim to uncover the achievable inclusion rates of novel ingredients in animal feed ration. Building on these efforts, the main goal of the proposed internship research project is to implement a sensitivity and uncertainty analysis of the feed formulation model, combined with its coupling with life cycle assessment (LCA) calculation, in order to unravel the environmental consequences of integrating novel feed in animal diets.

Description

The internship proposes to focus on the post-production environmental impacts of novel feed ingredients. When included in animal feed formulation, these displace/substitute conventional ingredients (such as soybean meal, wheat, etc.) based on their nutritional composition, their price, the nutritional requirements of target animals (specific to species and stage of life), and, increasingly, environmental indicators. Feed formulation are commonly established through multi-objective optimization algorithms (for example, here). Yet, when it comes to novel ingredients, input data is not really certain, and it remains unclear which data matters the most (that is, where having good data is essential to the outcome of the model). Therefore, a first task of the internship consists in uncovering to which extent the variation of each specific biophysical properties of novel ingredients shapes their potential inclusion rate in animal diets. This will be performed by designing and implementing state-of-the-art sensitivity and uncertainty analysis strategies applied to the optimization algorithm, written in Python. Then, the model will be expanded to be paired with LCA software calculation tools (also Python-based), with the objective to automatize the evaluation of the environmental impacts of feed formulations. The sensitivity/uncertainty method previously developed will further be applied to identify improvement leverages regarding input data quality, and

the reduction of the environmental impacts of feed formulations, and to position novel feeds in this landscape. Depending on selected candidate's affinity, the model will also be amended with additional indirect consequences of modifying animal diets with novel ingredients, such as the change in zootechnical performances (for example, increased time to maturity, increased excreta generation), in the nutritional profile of animal products (for example, presence of anti-nutritional compounds), as both influence the cradle-to-grave environmental performances.

Required qualification

- Being enrolled as a Master 2 student or equivalent (corresponds to a Master thesis project)
- Domains: Environmental or Biochemical or Industrial engineering or Agricultural or Animal science
- Willing to learn, proactivity, autonomy, rigor, curiosity
- Either proficiency in French and/or English (both not required)
- Python coding experience is an asset, but not mandatory as far as there is a willing to learn, the same applies for previous LCA knowledge (theory and practice).

Application procedure

To apply, please submit your updated **CV and cover letter** describing your interests in, and fit for, the position to javourez@insa-toulouse.fr using in the subject line of your email: [Uncert NovFeed Application – *your name*].

Applications will be reviewed on a rolling basis until the position is filled, but those received by **January 10th, 2024** will be guaranteed full consideration. Only short-listed applicants will be contacted.

Period:	**6 months, starting from 1st of March 2024 (or at latest 1st of April)**
Place:	**Toulouse Biotechnology Institute (TBI), INSA Toulouse, 135 Avenue de Rangueil, 31400 Toulouse**
Benefits:	**4.05€/h (35h/week). 50% of public transport fees refunded.** **Office equipment including a laptop is provided during the internship.**
Contact:	**Dr. Ugo Javourez (javourez@insa-toulouse.fr), Post-doctoral fellow in the team** **Main supervisor: Prof. Lorie Hamelin (hamelin@insa-toulouse.fr), lead scientist**

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More about our Bioeconomy group

The research group is led by Prof. Lorie Hamelin, who holds the Professor Chair on Transition towards low fossil carbon awarded by the *French National Institute for Agriculture, Food and Environment* (INRAE). The group carries out research on Sustainable Bioeconomy Transitions at the *Department of Sustainable Process Engineering* of INSA Toulouse. Within our work, the environmental efficiency of >100 bioeconomy conversion pathways has been assessed towards the horizon 2050. The vision is to contribute to the most comprehensive and integrated bioeconomy strategy in Europe. A YouTube Channel of the group is available here. We are well acknowledged nationally and internationally, as reflected by our involvement in several large national projects related to bioeconomy (FairCarboN) or bio-based materials (B-BEST), as well as European projects (ALIGNED, LCA4BIO). Our postdocs, PhDs, visiting PhDs, and master students come from all over the World. This all provides a unique dynamic international and multi-disciplinary environment to carry out meaningful and frontier research experience.