RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

INRAE

Bioeconomy for urban areas

Exploratory project
2022

© M. Mahdi Karim - Wikipédia

Coordinators
Christelle Planche (UR QuaPA)
christelle.planche@inrae.fr
Patrick Borel (UMR C2VN)
patrick.borel@univ-amu.fr

Keywords
Insect
Entomoconversion
Biowaste
Bioeconomy
Circular economy
Urban/peri-urban areas

INRAE divisions
ALIMH
AGROECOSYSTEM
MICA
TRANSFORM

FLY4WASTE

Assessing the risks and benefits of the entomoconversion of urban and peri-urban biowaste by the insect Hermetia illucens

> Evaluate the potential benefits and risks of using entomoconversion to valorise bio-waste from urban and peri-urban areas

Context and challenges

Some insect species like the black soldier fly (*Hermetia illucens*) can grow on a wide variety of organic substrates ranging from "noble" by-products (wheat bran) to waste such as pig slurry. This capacity is now seen as an ecological way to recycle biowaste. Given that total global production of waste will reach 3.4 billion metric tonnes per year, entomoconversion could be an interesting complement to existing methods like composting, micro-methanisation, or incineration to tackle this major challenge. Further, entomoconversion is a possible way to recover biowaste since the larvae could be transformed into very protein-rich meal for use in animal feed, to give one example. *Hermetia illucens* larvae are also very rich in anti-microbial compounds (lauric acid, peptide) and lipids which could serve as energy-dense nutrients or be converted into biofuel. The same larvae may also contain high concentrations of micronutrients (minerals, trace elements and vitamins) that boost their nutritional value for use in food for people or feed for animals. Lastly, when they are developing, larvae produce excrement (frass), that can be used as a natural fertilizer, and chitin, the basis of chitosan used in a variety of industrial applications. Insect rearing (entomoculture) is thus seen as an ecological way to recycle waste and organic residue and recover agro-industrial co-products (entomoconversion). In this context, the project will test the circular bioeconomy concept to simultaneously assess the benefits but also potential risks of using entomoconversion to recover biowaste from urban and peri-urban areas.

Goals

The black solider fly is already being used to turn food-grade by-products and residue into a range of products that are already on the market. The main goal of FLY4WASTE is to assess the extent to which this insect could, if regulations allow, be exploited more widely to recycle urban and peri-urban biowaste with a view to achieving a circular bioeconomy. The primary focus of our research

will be to assess the main benefits and risks associated with using entomoconversion to recover biowaste from urban and peri-urban areas.

As the risks and benefits are potentially very varied, the project will combine several disciplines to:

1. Evaluate the nutritional, health (chemical, microbiological), economic and social dimensions of entomoconversion, and then to
2. use all these criteria to perform a risk-benefit analysis of different scenarios for this type of biowaste recycling.

If entomoconversion is to be successfully harnessed to recycle urban and peri-urban waste, in the long term, it will be necessary to extend the risk-benefit analysis to other dimensions by involving different partners in this inter-disciplinary project, especially concerning:

- Societal acceptability
- Use of entomoconversion products in animal feed
- Genetic selection of the insect
- Optimisation of entomoconversion procedures or processing of derived products
- Environmental impact

Project members

INRAE division	Units	Expertise and contributions
AGROECOSYSTEM	UMR ITAP	Economic and social assessment of the entomoconversion of biowaste
ALIMH	UMR C2VN	Nutrition, bio-accumulation of micro-nutrients with health value
MICA	UMR MICALIS	Microbiological safety of biowaste and insects. Entomoconversion and reduction of +/- sporulated pathogens
	UMR SQPOV	Microbiological safety of entomoconversion products. Adaptation of spore-forming Gram+ bacteria
TRANSFORM	UR QuaPA	Chemical safety of biowaste used in entomoconversion products (transfer, bioaccumulation and bioamplification of contaminants)
	UMR IATE	Risk-benefit analysis; multi-criteria and multi-player analysis; arguments & decision
Partners		Expertise and contributions
Société BioMiMetiC (FRANCE)		Entomoconversion; Insect rearing on biowaste
Société PAPREC (FRANCE)		Supplying different categories of biowaste