SUSINCHAIN
SUSTAINABLE INSECT CHAIN

SUSINCHAIN PROJECT: UPSCALING THE EUROPEAN INSECT CHAIN

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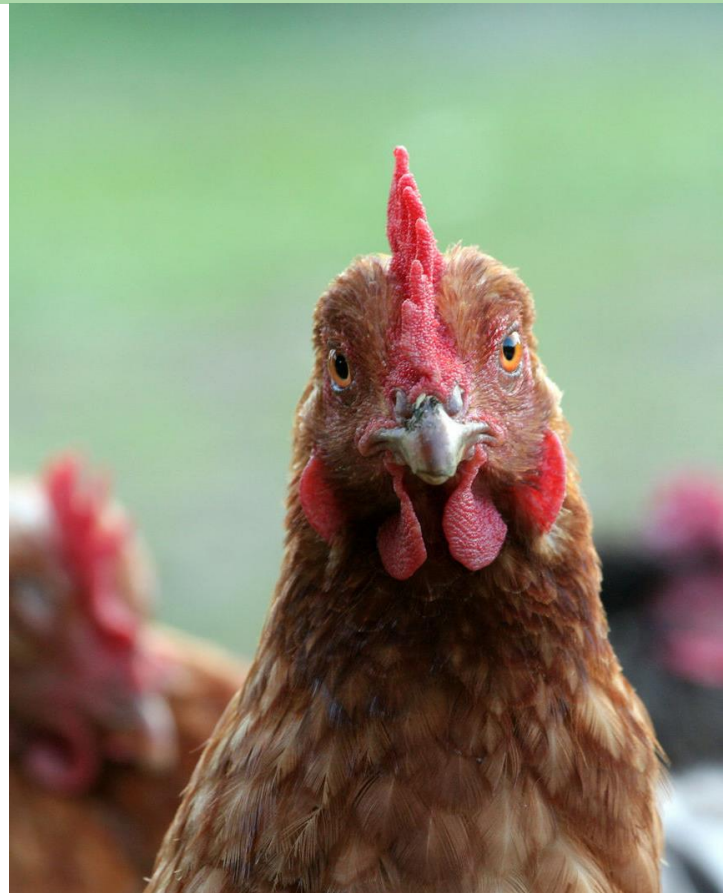
Content

- General data & consortium
- Objectives Susinchain
- Robustness
- Sustainability
- Food safety

General data

- H2020-SFS-2019-1
- Type of Action: Innovative Action
- Acronym: SUSINCHAIN = SUStainable INsect CHAIN
- 01 Oct 2019 – 31 Sep 2023
- EU Contribution: €8 mln



SUSINCHAIN participating countries

35 partners:

7 insect producing companies

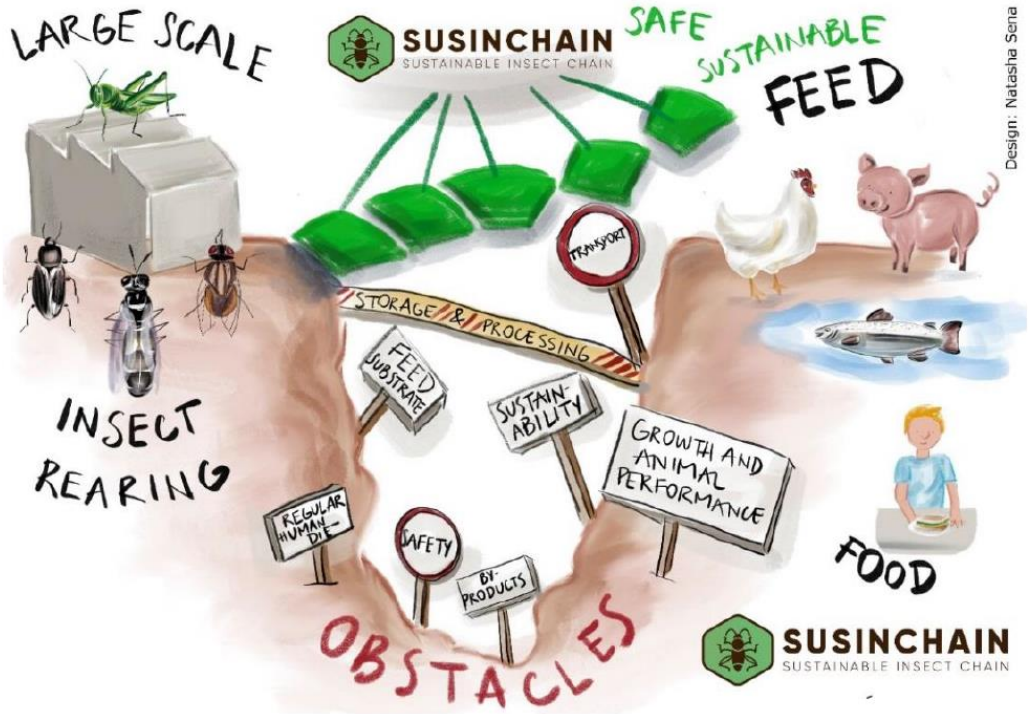
4 processing and equipment companies

4 feed producing companies

3 consultancy and food research companies

17 academic and applied research groups

SUSINCHAIN challenges to fill the demand-supply gap



Challenges to be addressed to fill the gap between insect protein demand and supply

Objective

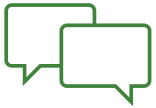
The overall objective of SUSINCHAIN is to **test, pilot and demonstrate** recently developed innovations, including **techniques, products and processes**, and enabling full maturation and commercialisation of the European insect value chain.

- **business models, market opportunities, best (and worst) practices, roadmap**
- large-scale commercial rearing of insects, transport, storage
- processing technologies
- insect-derived proteins in animal diets
- integration of insects as part of daily meals
- **safety of insects and insect-derived products**
- **decision support system ensuring economically and environmentally sustainable insect chain**
- strategies and business plans for exploitation of project results, communication and dissemination

What about the robustness of insect production?

Exploring the robustness of three potential business models for insect production

Expert interviews and Focus groups



Impact assesment of scenarios on business model components through the Business Model Stress Test (Haaker et al. 2017)

Three business models

- Full-liner BSF production for pet food
- Decentralised BSF production for aquafeed
- Mealworm processing cooperative for food

Three uncertainties

1. Regulations on the use of side streams
2. Insect welfare regulations
3. Sustainability requirements & energy prices

Niyonsaba et al., 2023, submitted

Conclusions robustness insect production

Full-liner BSF production for pet food

Decentralised BSF production for aquafeed

Mealworm processing cooperative for food

More robust

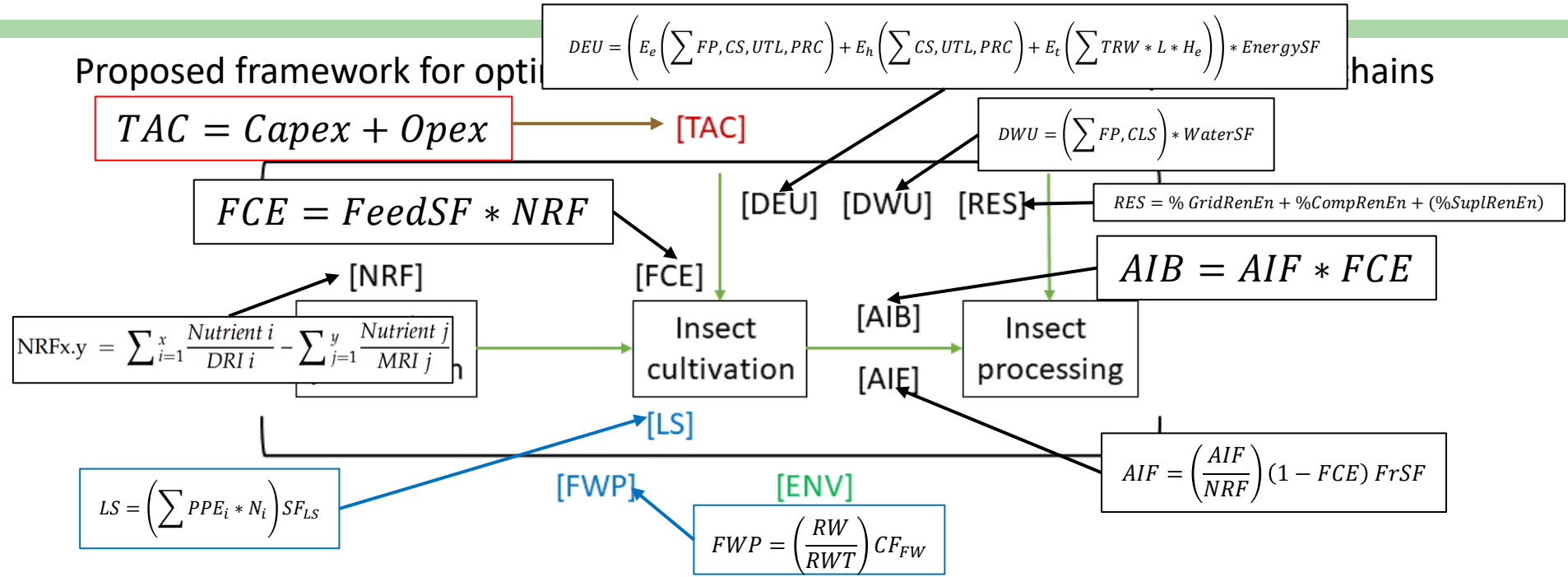
- Differences were related to customer segment, value proposition, revenue and cost structure
- **Strict regulations** have the least negative or even a positive impact on business model robustness
- **Rising energy prices** have a negative impact on business model robustness

Niyonsaba et al., 2023, submitted


Is insect production for food and feed
in Europe sustainable?

Sustainability is complex and … complicated…

Proposed framework for opti … hains



Criteria is in square brackets, red – economic, green – environmental, blue – social, black – applicable to a few aspects; AIB – amount of insect biomass; AIF – amount of insect frass; DEU – direct energy use; DWU – direct water use; ENV – integrated environmental impact; FCE – feed conversion efficiency; FWP – fair wage potential; LS – labor safety; NRF – nutritional value of feed; RES – renewable energy share; TAC – total annual cost

Smetana, Paguero, Green, Silva, Bhaita, Ristic, Tonda, Mouhrim, Mathys, Heinz (2022) under revision

Environmental impact of insect production in Europe

JOURNAL ARTICLE

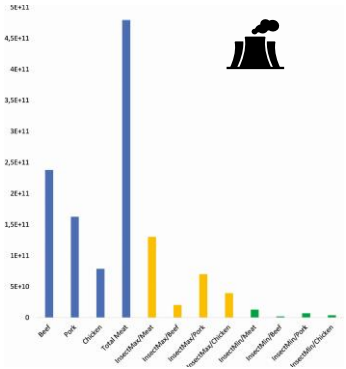
Environmental impact potential of insect production chains for food and feed in Europe

Sergiy Smetana, Anita Bhatia, Uday Batta, Nisrine Mouhrim, Alberto Tonda

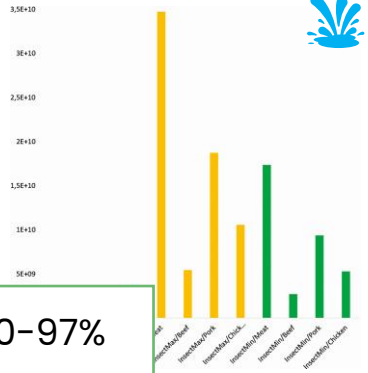
Animal Frontiers, Volume 13, Issue 4, August 2023, Pages 112–120,
https://doi.org/10.1093/af/vfad033

Published: 14 August 2023

Greenhouse gas emissions

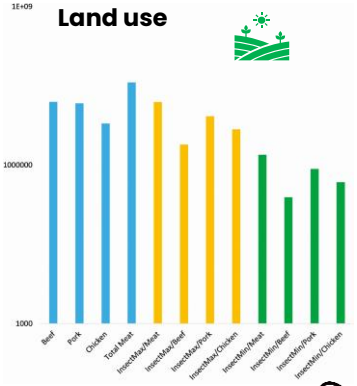


Water footprint

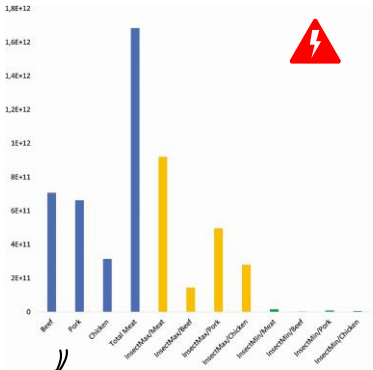


40-97%

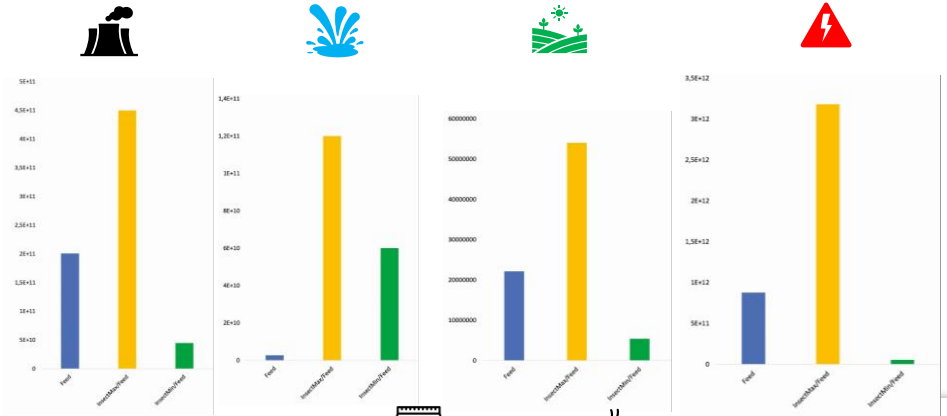
Land use



Non-renewable energy use



75-93%

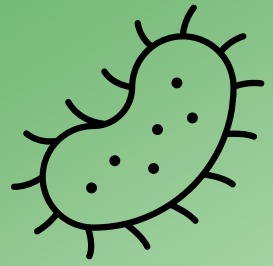


Key messages sustainable insect production

- Insects are a potential **sustainable** and healthy source of protein for human consumption
- Insect require **less land, and resources** to produce compared to traditional livestock, but not always! Eating insects can help **reduce greenhouse gas emissions** and combat **climate change**
- **Feed**ing insects to animals can bring sustainable benefits, in case of **feeding with waste-streams**

→ Public authorities should consider implementing policies and regulations that support the development of the insect sector (**especially waste-to-insect-food/feed approaches**),

What about food safety of insects?



What about food safety?

When upscaling the insect production safety should be ensured

- Safe-by-design rather than end-of-pipe approach
- Substrates: microbiological and chemical hazards
- These hazards may / may not accumulate in insect larvae

Objective: To investigate possible accumulation of chemical and microbiological hazards from substrates into insect larvae

Chemical Food Safety Hazards

Journal of Insects as Food and Feed, 2021 online ARTICLE IN PRESS

Wageningen Academic Publishers

SPECIAL ISSUE: Advancement of insects as food and feed in a circular economy

Chemical food safety hazards of insects reared for food and feed

A.M. Meyer, N. Meijer, E.F. Hoek-van den Hil and H.J. van der Fels-Klerx*

Wageningen Food Safety Research, Akkermaalsbos 2, 6708 WB Wageningen, the Netherlands; ine.vanderfels@wur.nl

Received: 23 July 2020 / Accepted: 1 October 2020

OPEN ACCESS REVIEW ARTICLE

- Most data for *H. Illucens* and *T. molitor*
- Accumulation of certain heavy metals (lead, arsenic, mercury, and cadmium) in certain species
- Mycotoxins and PAHs seem not to accumulate
- No or low accumulation for pesticides and veterinary drugs
- Mycotoxins and veterinary drugs could be degraded, metabolic routes need r
- Pesticides and veterinary drug residues can affect growth and survival of inse
- Data limited, namely for PAHs, plant toxins, and dioxins + dl-PCBs

Main findings of experimental studies with contaminants

Contaminant		Insect species	Effect on larval weight, survival	Transfer or bioaccumulation	Tested metabolite formation or incomplete mass balance
Plant toxins	Pyrrolizidine + tropane alkaloids	BSFL	No	Transfer	Yes
		LMW	No	Transfer	Yes
Veterinary drugs	Antibiotics	BSFL	No*	Transfer	Yes
	Coccidiostats		No	Transfer	Yes
	Antiparasitic drugs		Yes	Transfer	Yes
Hormones	Synthetic and natural: estrogens, progesterones, testosterone	BSFL	No	Transfer	Yes
PFAS	PFOA, PFOS, PFNA, PFHxS	BSFL	No	Bioaccumulation	No
		LMW	No*	Transfer	No
Microplastics	Various types/sizes of MPs	YMW	No	Type-dependant transfer	n/a
Insecticide residues	Cypermethrin, deltamethrin	BSFL	yes	transfer	Yes

*details e.g., per individual compound might differ from this table!

Experimental studies contaminants

General observations:

- Accumulation in insects is low for most contaminant groups tested
- Some metabolization occurs (e.g. plant toxins, veterinary drugs, hormones)
  - Unidentified or unknown metabolites might be produced by the insects as well
- In some case, insect production is reduced (insecticides, veterinary drugs)

Case-by-case evaluation needed: insect species x substrate x contaminant

→ Differences between insect species and between chemical contaminant groups

Microbiological Food Safety Hazards

Top-3 biological risks associated with insects to be used food and feed: ***S. aureus***, ***Clostridium*** species, ***B. cereus*** **group**

Risk assessments on the transfer of biological contaminants during rearing of insects: focus on challenge tests

Journal of Insects as Food and Feed, 2021 online **ARTICLE IN PRESS**

Wageningen Academic Publishers

SPECIAL ISSUE: *Advancement of insects as food and feed in a circular economy*

Biological contaminants in insects as food and feed

D. Vandeweyer[1,2≠], J. De Smet[1,2≠], N. Van Looveren[1,2] and L. Van Campenhout[1,2*]

[1]KU Leuven, Department of Microbial and Molecular Systems (M²S), Lab4Food, Geel Campus, Kleinhoefstraat 4, 2440 Geel, Belgium; [2]KU Leuven, Leuven Food Science and Nutrition Research Centre (LFoRCe), Kasteelpark Arenberg 20, Box 2463, 3001 Leuven, Belgium; leen.vancampenhout@kuleuven.be; ≠These authors contributed equally

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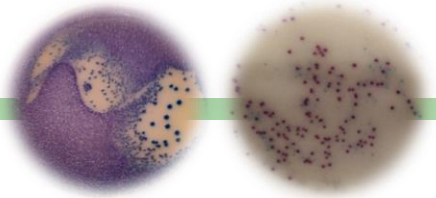
OPEN ACCESS **REVIEW ARTICLE**

Challenge tests with pathogens



Results were case-dependent

- *Salmonella* x mealworms
  - ➔ Limited horizontal transfer to mealworms
  - ➔ Small reducing effect of mealworms on *Salmonella* presence in substrate
- *Salmonella* x BSF larvae
  - ➔ Horizontal transfer to BSF larvae
  - ➔ No effect of BSF larvae on *Salmonella* presence in subst
- *S. aureus* x BSF larvae
  - ➔ No horizontal transfer to BSF larvae
  - ➔ High reducing effect of BSF larvae on *S. aureus* presence in substrate
- *S. aureus* x mealworms
  - ➔ Low horizontal transfer to mealworms (and absent after 6 days)
  - ➔ Increased reducing effect of mealworms on *S. aureus* presence in substrate

Conclusion

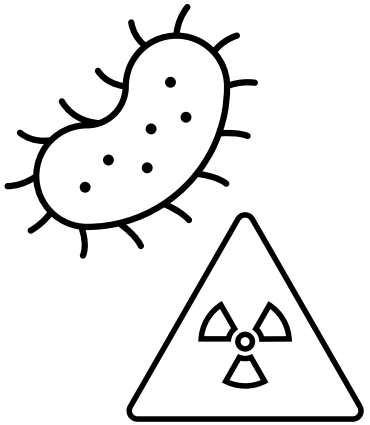
Fate of foodborne pathogens during rearing depends on bacterial species, insect species, inoculation level, etc.

Conclusions on food safety

With the emerging insect value chain, safety needs to be addressed on safety-by-design approach

Needs case specific focus, per insect x substrate x hazard

Possible break-down mechanisms of contaminants by insects; these can provide great opportunities, but first need further investigation



SUSINCHAIN
SUSTAINABLE INSECT CHAIN

About | News & Calendar | Project Outcomes | Stakeholder Platform | Horizon4Proteins | Contact

SUStainable INsect CHAIN (SUSINCHAIN) aims to contribute to novel protein provision for feed and food in Europe by overcoming the remaining barriers for increasing the economic viability of the insect value chain and opening markets by combining forces in a comprehensive multi-actor consortium.

Read More

The project is funded by the European Union's Horizon 2020 Research and Innovation programme.

Other outcomes and Roadmap

- Food safety
- Robustness
- Sustainability

www.susinchain.eu

Acknowledgements

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Elise F. Hoek- van den Hil (Presenter), Wageningen Food Safety Research

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