Insect potential in upgrading food waste streams to feed
From linear to circular economy
Insect in circular economy

- Insect rearing
- Processing (Feed and non feed production)
- Food waste
- Animal nutrition

Food
July 1: A milestone for insect protein

As of July 1, 2017, insect protein will be allowed to be used in aquafeed. The insect sector is thrilled that this milestone to start using insect protein is now official.

The EU Regulation 2017/893 now permits the use of insect proteins as fish feed, derived from the following insect species:

- Black Soldier Fly (*Hermetia illucens*) and Common Housefly (*Musca domestica*)
- Yellow Mealworm (*Tenebrio molitor*) and Lesser Mealworm (*Alphitobius diaperinus*)
- House cricket (*Acheta domesticus*), Banded cricket (*Gryllodes sigillatus*) and Field Cricket (*Gryllus assimilis*)

The use of insect protein for other livestock species is not allowed yet.

In the wake of this legislative reform, IPIFF President Antoine Hubert reacted: "We are particularly pleased with the opening of this legislation, which constitutes a major milestone towards the development of the European insect production sector".

"We also trust that this legislation will bring new opportunities for the European aquaculture sector, as insects should represent a promising source of proteins for farmed fish in the near future: as being a natural component of the diets of carnivorous fish, whilst combining high proteins levels - between 55% and 75% - and excellent digestibility; performance, insects are well suited to complement feed..."

IPIFF publishes guidance document for insect producers

IPIFF, the International Platform of Insects for Food & Feed has produced a guidance document on the best practices in quality and hygienic insect production.

The overall objective of the guide is to help insect producers for food and/or animal feed purposes to achieve a high level of consumer protection and animal health through the production of safe products. To this end, the guide provides guidance to insect producers to effectively apply EU food and feed safety legislation, while providing an incentive for them to develop a robust food and feed safety management system. In addition, the guide specifies requirements enabling to:

1. Ensure that insect producers conform to their stated food and feed safety policy and demonstrate their commitments in this regard.
2. Help the insect producers to effectively communicate food and feed safety issues to the regulatory authorities, and when needed, to their suppliers, customers and relevant interested parties (i.e. consumers) in the food and feed chains.

1. Black soldier fly
2. House fly
3. Yellow mealworm
4. Lesser mealworm
5. House cricket
6. Banded cricket
7. Field cricket
Insects as feed

Substrates

Allowed
- Vegetable substrates
- Unprocessed former food (dairy and eggs)

Banned
- Unprocessed former food (meat and fish)
- Catering waste and slaughterhouse products
- Animal manure

Insects species/meal

Targets

- Protein
- Fat

animal

Review: Insects and former foodstuffs for upgrading food waste biomasses/streams to feed ingredients for farm animals

L. Pinotti, C. Giromini, M. Ottoboni, M. Tretola and D. Marchis

1 Department of Health, Animal Science and Food Safety, University of Milan, Milan 20134, Italy; 2 Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle d’Aosta, Turin, Italy
Black soldier fly life cycle

Spranghers, Ottoboni et al., 2018
Substrates proposed
(Spranghers, Ottoboni et al., 2017; Meneguz et al., 2018)

Insect can potentially be used to upgrade low value organic waste streams

Digestate
Vegetable Waste
Restaurant waste
Poultry feed+water
Golden standard

The New Energy plant...

- Intake pit
- Size reducer
- Intermediate storage
- Fermenter
- Gas motor
- Generator
- Electricity
- Heat
- Fertilizer

Brewery by-products
Wine by-products
Time needed to reach the harvesting stage

Pinotti & Ottoboni 2019
Production grams of larval biomass yield starting from 100 young larvae

Ottoboni & Pinotti 2019
Ability to upgrade low value substrate

Energy content in rearing substrates and deriving BSF larval biomass.

Ottoboni & Pinotti, 2019

+60%
Ability to upgrade low value substrate
MACRO NUTRIENTS

Ottoboni & Pinotti, 2019
Summary 1/2 (*Substrate*)

**Efficiency**
- High MOISTURE, and
- high FIBRE substrates

**Quality**
- Protein content and quality is high (no substrate effect)

- Wet substrate (8% DM) has reduced larvae’s mortality
- Water rich material with limited pre-processing
- Larvae are able to efficiently bioconvert wastes and by-products high in fibre content (38-55% NDF) without any detrimental effect on their growth performance.
Summary 2/2 (Time)

- Time needed to reach harvest phase is variable
  - 1-3 wks, species, substrate dependent
- Micro-livestock features (environment, density,..)

Thank you for your attention

DR Matteo Ottoboni
INSECT METHAMORPHOSIS

COMPLETE
88% of all insects
- Four Stages
  1. Egg
  2. Larva
  3. Pupa
  4. Adult

INCOMPLETE
12% of all insects
- Three Stages
  1. Egg
  2. Nymph
  3. Adult

COMPLETE
- e.g. butterfly, housefly, bees
  1. black soldier fly,
  2. house fly,
  3. yellow mealworm,
  4. lesser mealworm,

INCOMPLETE
- Cricket, locust,
  1. house cricket,
  2. banded cricket
  3. field cricket
Type of development: source of variability
Seven insect species (see Chapter II of Annex X to Regulation 142/2011), have been authorized, namely

1. black soldier fly,
2. house fly,
3. yellow mealworm,
4. lesser mealworm,
5. house cricket,
6. banded cricket
7. field cricket.
Challenges to adding insect materials to farm animal feeds/diets

• Variation in nutrient content and nutrient availability between batches/sources...

• Technical aspects/quality: processing, feed technology...

• Co-product handling, storage, and transportation...

• Effect on animal performance, end-product quality....

• Safety ....
Technological quality: effect of Insect life stage

Rationale of the study:

– to add insect material without processing (high moisture)
– To test the physiological stage: I.E. **PREPUPAE VS LARVAE**

*Technological treatment investigated: extrusion*

Ottoboni et al., 2018: IJAS
Insect in circular economy

Insect rearing

Processing

Aquafeed