Opportunities and challenges of producing insects at industrial scale

Circular Bioeconomy Days 2019

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Insects have ‘tailwind’... but still some distance to go
Main challenges of the insect industry

- **Upscaling (industrial level)**
  - Insect biology in production environment
  - Development of (customized) automation
  - Development of species- and life-stage specific feed

- **Legal barriers (EU) in feed and food**
  - Increasing the knowledge-level on feed/food safety of insects
  - Political priority to promote the use of insects as feed/food

- **Consumer acceptance (mainly as food)**
  - Information...
Upscaling: EU volume forecast

Estimated volumes of insect protein in Europe (kilo tonnes/year)

IPIFF vision paper 2018
# Upscaling: Top performers

<table>
<thead>
<tr>
<th>Species</th>
<th>Development time (egg-adult)</th>
<th>Macro-nutrition (%DM)</th>
<th>FCR*</th>
<th>Protein yield t/ha/yr and t/m³/yr</th>
<th>Current EU production level (t ww/yr)</th>
<th>Expected sales price (€ t/DM)</th>
<th>Main markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenebrio molitor (Common mealworm)</td>
<td>60-70 days</td>
<td>Protein: 45-55 Fat: 20-35</td>
<td>4-6</td>
<td>ha: ca. 100 m⁻³: ca. 0.1</td>
<td>1,000-5,000</td>
<td>3,300-13,500</td>
<td>Food Pet food</td>
</tr>
<tr>
<td>Alphitobius diaperinus (Lesser mealworm)</td>
<td>40-50 days</td>
<td>Protein: 50-60 Fat: 20-30</td>
<td>3-5</td>
<td>ha: ca. 200 m⁻³: ca. 0.2</td>
<td>1,000</td>
<td>3,300-13,500</td>
<td>Food Pet food</td>
</tr>
<tr>
<td>Hermetia illucens (Black soldier fly)</td>
<td>20-25 days</td>
<td>Protein: 35-45 Fat: 15-35</td>
<td>2-3</td>
<td>ha: &gt;600 m⁻³: ca. 0.4</td>
<td>1,000-5,000</td>
<td>1,300-3,300</td>
<td>Feed Pet food</td>
</tr>
</tbody>
</table>

*Feed Conversion Rate based on dry matter conversion

Fischer et al., 2019
Upcoming: Heat… a ‘double-edged sword’

Insects are cold-blooded (poikilotherm) animals, but still emitting ~15W/m²

Combining biological data with CFD modelling to simulate key parameters @ large-scale
R&D in Denmark 2018/2019 (>100k €)

Black Soldier Fly (BSF)
- **WICE** (390k €, MUDP)
- SUPERIOR (375k €, MUDP)
- Green Biorefining (360k €, F&I)
- BIOCAS (~100k €, Interreg/EU)
- WICE4SOIL (~260k €, MUDP)
- ENORM (~100k €, IFD)
- ENORM BioFactory (~8.7M €, MUDP)

Mealworms
- **inVALUABLE** (3.7M €, IFD)
- **SUSMEAL** (1.1M €, IFD, Eurostars)
- Consibio (~100k €, IFD)
- Wholi Foods (~100k €, IFD)
- ENORM (~100k €, IFD)
- NLF (135k €, IFD)
- Ikadan (135k €, IFD)

>16M € portfolio

Crickets
- InUrban (~600k €, GUDP)
- Syngja (200k €, IFD)
- Synjga2 (185 €, FFI)
EU Legislation – feed (generic)

Seven species defined by EU as farmed animals for feed use

Feedstocks
- Plant-based substrates
- Unprocessed former foodstuff: dairy and eggs
- Unprocessed former foodstuff: meat and fish
- Catering waste and slaughterhouse products
- Animal manure

Insect production

Target species

<table>
<thead>
<tr>
<th>Protein</th>
<th>Fat</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>
| ✔️ | ✔️ | ✔️ | 1
| ✔️ | ✔️ | ✔️ | 2
| ✔️ | ✔️ | ✔️ | 2

Currently legal US/CA – EU expected in 2019
Currently not legal EU or US/CA – EU expected in 2020+
EU Legislation - food

Summary of ongoing applications and notifications

Novel Food applications on insects
Common mealworm
Lesser mealworm
Black soldier fly
Honey bee
House cricket
Banded cricket
Migratory locust
Thank you for your attention

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