Processing insects for the production of protein

Insects: A new protein source for Europe?

Circular Bioeconomy Days
Aarhus University, Forskningscenter Foulum, Denmark

DIRK SINDERMANN, TJELE, DENMARK, 27TH JUNE 2019
GEA – “engineering for a better world”

GEA is one of the largest suppliers of process technology to the food industry and to a wide range of other industries.

The international technology group focuses on process technology, components and sustainable energy solutions for sophisticated production processes in diverse end-user markets.

The company is listed on the German MDAX stock index (G1A, WKN 660 200) and included in the STOXX® Europe 600 Index. In addition, the company is listed in selected MSCI Global Sustainability Indexes.

- 4,751 million order intake (EUR)
- 17,863 employees (FTEs)
- 4,605 million revenue (EUR)
- 564 million operating EBITDA (EUR)
- 1.31 earnings per share (EUR)
- 12.2 % operating EBITDA margin

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Our applications – in touch with GEA every day

Dairy Farming and Processing
- Approx. one quarter of processed milk comes from GEA production systems

Food
- Every third chicken nugget is produced using GEA technology
- Approx. every third process line for instant coffee was installed by GEA
- Approx. every second liter of beer is brewed with the aid of systems and process solutions from GEA

Beverages
- Every fourth liter of human blood for making plasma-derived products is processed using GEA equipment

Pharma
- More than one third of all polymer producers are using GEA drying technology

Chemical
- Each industry we serve utilizes industrial refrigeration technology from GEA

Utilities
- Every second container ship in the world sails with GEA marine equipment on board

Marine
- Dairy Farming and Processing
Processing insects for the production of protein
Image of Insects in Western Cultures
We will have to feed 9.7 billion people.

Population development

2019 - 2050
GEA activities in protein production – today and tomorrow

Animal proteins

Plant proteins

Alternative proteins
Impacts of conventional protein production

On land
- Water use and pollution
- Land use
- Greenhouse gases

In the ocean
- Feed price volatility
- Soil degradation
- Antibiotic resistance
- Habitat loss
- Overfishing

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Sustainability of Insects?

Gallons of water needed to produce one pound of meat

Pound of feed needed to produce one pound of digestible meat

Greenhouse gas emissions

1 G = 3.8L / 1P = 0.45 kg
Potential for Food, Feed and Bio Materials

Feed

Food

Bio materials

Aquacultures

Livestock

Petfood

Food additives

Protein-fortified dry products

Functional additives

Snacks

Edible fats

Fertilizer

Chitin

Biofuel

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Estimated Protein Production from Insects within Europe

Estimated volumes of production of insect protein until 2025 in Europe (in thousands of tonnes)

Source: IPIFF questionnaire October 2018
Insects for Food: Mealworm Larvae

Lesser Mealworm (Little Beetle)

*Alphitobius diaperinus*
Insects for Food: Burgers from Mealworm Larvae

- Co-creation @GEA
- Insect burger
- New: up to 64% insects inside
Fundamental principles of centrifugal separation

Density difference: Separators and decanters can be used for the separation of the following liquid mixtures:

- Liquid/solid
- Liquid/liquid
- Liquid/liquid/solid
Insects for Food: Recovery of Protein and Fat from Mealworm Larvae
Insects for Feed: Black Soldier Fly Larvae

Black Soldier Fly (BSF)

*Hermetia Illucens*
## IPIFF roadmap on the use of insects in animal feed

<table>
<thead>
<tr>
<th>Feedstocks</th>
<th>Insect production</th>
<th>Target species</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Plant-based substrates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Unprocessed former foodstuff:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dairy and eggs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Unprocessed former foodstuff:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>meat and fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x Catering waste and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>slaughterhouse products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x Animal manure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Step | Target | Timeframe |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Authorise insect proteins for aqua feed use</td>
<td>Target achieved Authorisation effective since 1 July 2017</td>
</tr>
<tr>
<td>2</td>
<td>Authorise insect proteins for use in pig and poultry feed</td>
<td>EU discussions may begin end-2018. Approval by Member States possible during the 1st quarter of 2019</td>
</tr>
<tr>
<td>3</td>
<td>Authorise 'former foodstuff' and/or catering waste as feed for insects</td>
<td>2020 onwards</td>
</tr>
</tbody>
</table>

http://ipiff.org/publications-position-papers/
Low Temperature Process
Process for Food and Feed

Fat
Stickwater
Solids
Low Temperature Process
Pilot Plants for Product Development

Pilot plants for protein and fat recovery from insects

Capacity: up to 500 kg/h or 10 t/d
Enzymatic Hydrolysis Process
Process for Food and Feed

Recovery of chitin
as separate phase possible

Pilot plant Haaksbergen, NL
Insects for Feed: Low Temperature Process
Devitalisation of Larvae
## Insects for Feed: Low Temperature Process

**Mechanical Separation**

![Industrial equipment](image)

### Composition BSF

<table>
<thead>
<tr>
<th>Component</th>
<th>BSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Substance</td>
<td>28 – 30 %</td>
</tr>
<tr>
<td>Fat</td>
<td>9 – 11 %</td>
</tr>
<tr>
<td>Protein</td>
<td>10 – 12 %</td>
</tr>
</tbody>
</table>

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### Composition of BSF Meal

<table>
<thead>
<tr>
<th>Composition</th>
<th>BSF Meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>6 – 10 %</td>
</tr>
<tr>
<td>Protein (DM)</td>
<td>54 – 64 %</td>
</tr>
<tr>
<td>Fat (DM)</td>
<td>8 – 12 %</td>
</tr>
</tbody>
</table>

#### Stickwater:

- Can be evaporated and added
- Reducing fat content and increasing protein content

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Insects for Feed: BSF Meal

Nutritional value of insect proteins

Source: Bühler, Networking days 2016
Fat from Black Soldier Fly:
- low in unsaturated fatty acids
- nutty taste and smell
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Insects life cycle

- Eggs
- Young larvae
- Larvae
- Pupae
- Adult insects

Fertilizer

Residue processing

Fats and proteins

Larvae processing

Rearing
Case Example

Production 25 – 35 days

365 day/a production

7 kg of (wet) feed for 1 kg larvae

Foot Print of 20,000 m² for 50,000 t larvae /a
Upscaling: Breeding and Rearing
Case Example

Feed Management

350,000 t/a
1,030 t/d
50 Trucks per day

Breeding & Rearing

Larvae (estimated)

50,000 t/a
7,700 h/a production
6.5 t/h capacity
Upscaling: Processing Case Example

Larvae (estimated)

Processing

Endproducts (estimated)

50,000 t/a
7,700 h/a production
6.5 t/h capacity

1.1 – 1.5 t/h Meal
0.5 – 0.7 t/h Fat
Upscaling Protein Meal and Fat Production Case Example

Feed-Management
350,000 t/a
1,030 t/d

Breeding & Rearing

Processing
8,500–11,500 t/a
1.1–1.5 t/h Meal

Distribution of Final Products
3,800–5,400 t/a
0.5–0.7 t/h Fat

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Future Green Solutions

Future Green Solutions
A business of tomorrow

Food Waste
Helping to solve the current food waste crisis. Diverting organic food waste from landfill, as use for BSF feed. Current research is investigating other organic wastes for feed.

Black Soldier Fly
Black soldier fly (Hermetia illucens) larvae are ferocious feeders that efficiently convert organic waste into high value proteins and oils for use in livestock and aquaculture feeds.

Soil Ameliorants
The resultant larvae castings can then be utilised as high grade soil ameliorants.

Waste Treatment
Currently investigating opportunities for BSF to treat problematic organic wastes.
Summary
Application

- Process know-how available
- All process steps can technically be covered
- Not replacing existing protein sources but helping to fill the protein gap sustainably
- Room for further innovations
• In many regions fit for food
• In many regions fit for feed
• Product design helps (for food)
• Movement where restrictions are still in place
Summary Technology

• We are ready, no new machines

• Opportunities for Farming (alliances and co-operations)

• Collecting further competence for alternative proteins
Outlook
Next steps

• Further testing with different raw material, substrates, equipment,…

• Committed regarding alternative proteins without losing focus on traditional applications

• Co-operating with partners to be able to offer complete solutions

• Open minded regarding new trends and developments