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Efficiency and scalability in producing feed from manure using the common housefly

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BioConVal – project background

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- **BioConVal** (**BioCon**version to **Val**ue) is a R&D project (04/2012-05/2014) carried out amongst Danish R&D institutes and European SMEs.

- The project aims at developing and demonstrating an integrated system for cultivating pathogen-free fly larvae (*Musca domestica*) in poultry manure locally at farms, and subsequently use them as dietary supplement for the livestock.

- Funding

ICROFS
International Centre for Research in Organic Food Systems

BioConVal – project partners

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R&D

Danish Technological Institute

National Food Institute, Technical University of Denmark (DTU)

DTU

Aarhus University (Dept. of Animal Science)

Knowledge Centre for Agriculture (Poultry) LANDBRUG FØDEVARER | VIDENCENTRET FOR LANDBRUG

SMEs

FARMERGØDNING I/S (Danish manufacturer of organic fertilizer)

E.W.H. Bioproduction ApS (Danish manufacturer of insects) BioProduction EWH

DORSET GM GREEN MACHINES (Dutch engineering company)

BioConVal – 'practical ambition'

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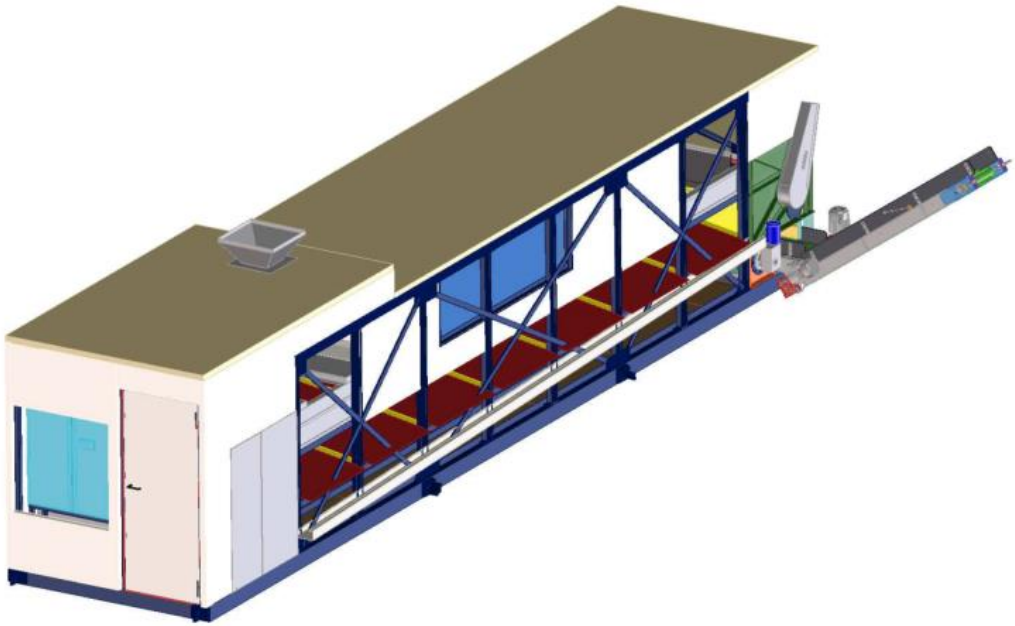
- Ambition: To develop a semi-automatic on-farm larvae production system for bioconversion of chicken manure



- Enclosed conveyor-based container system (perforated)
- Capacity: 1800 kg manure/week (equal to 2200 hens)
  - 1.8 kg fly eggs/week
  - 140 kg larvae/week
  - 1000 kg compost
- Automated load/unload of manure

Factors of importance…

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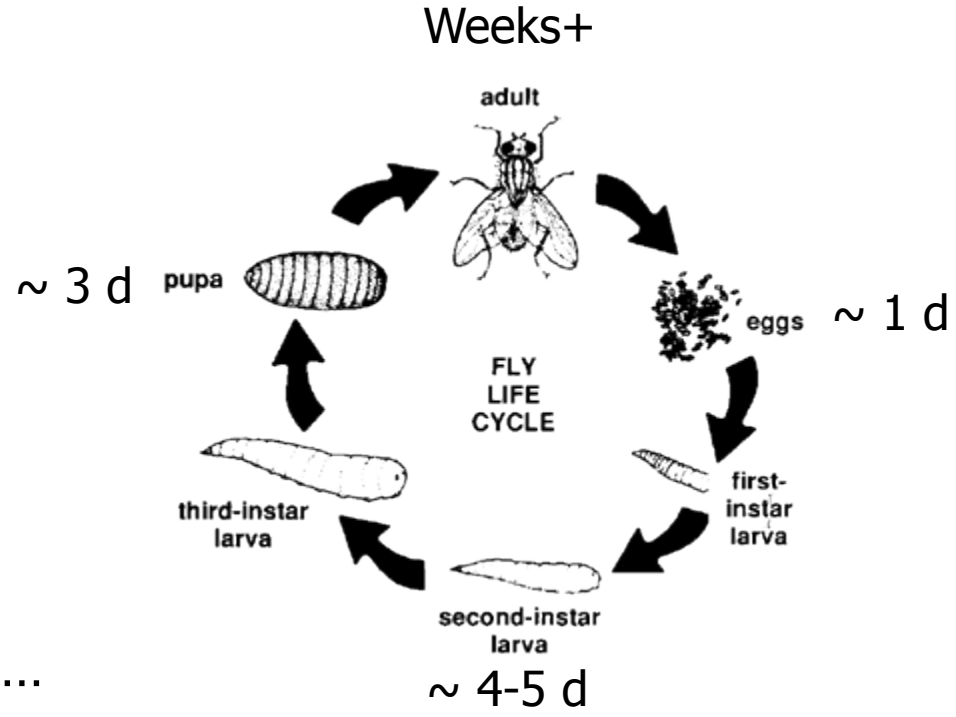
- Fly breeding
- Storage of fly eggs
- Larvae rearing
- Separation of larvae from manure
- Economic assessment

Musca fly breeding



- Egg collection…
- Development of 'manure-ball'
  - Different designs and types of textiles
  - Possibility to quantify eggs
    (reducing variability - improving yield)

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Storage of *Musca* fly egg

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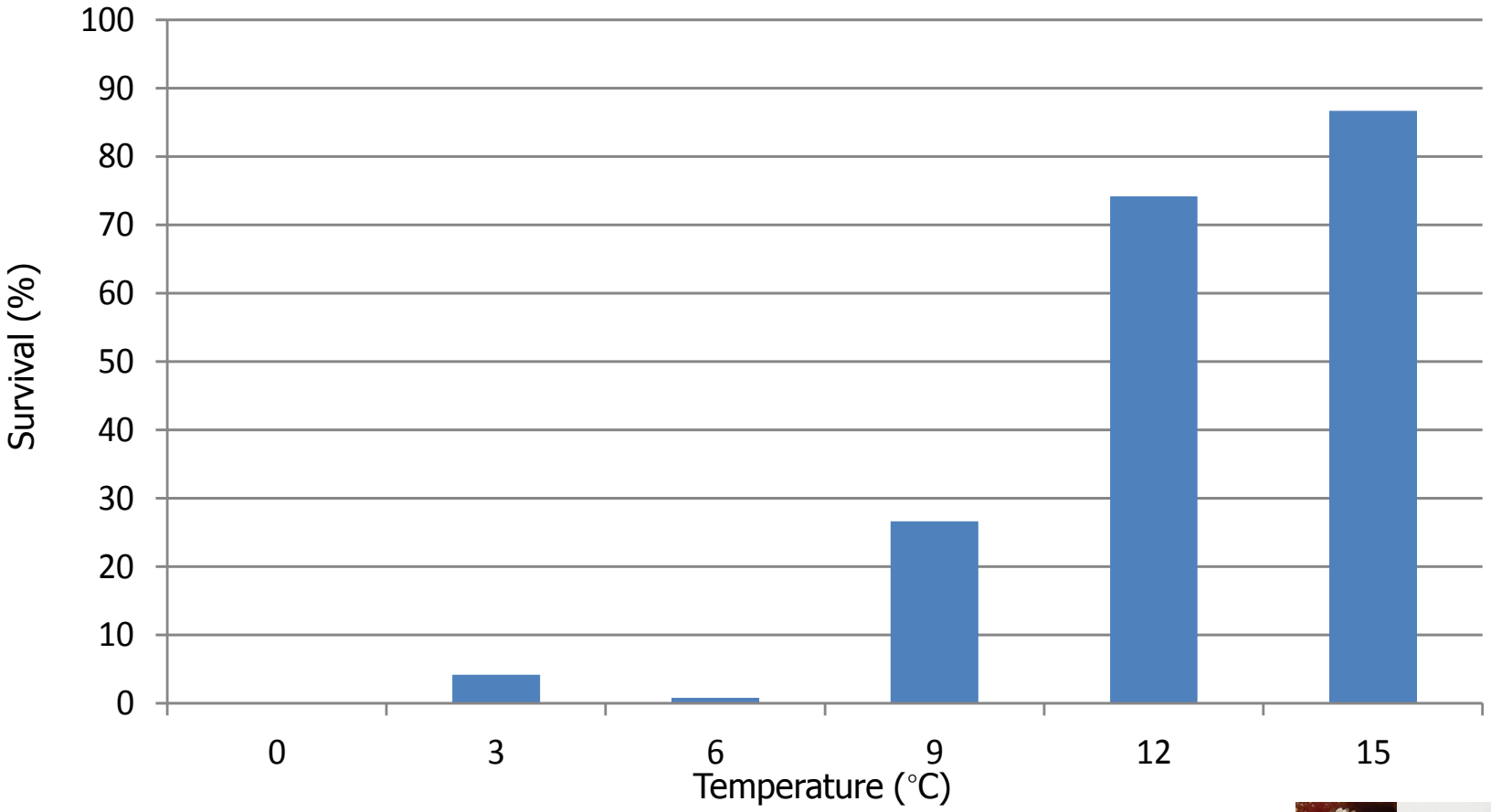
Hatchability at 25°C following 72 hr storage at different temperatures



Musca larvae rearing in manure

- Factors influencing feed conversion rate

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Process:	Manure and water	Larvae rearing	Harvest larvae	Compost
Mass:	80%+20%		8%	50%
Days:	1	1-4	5	

- Pre-treatment of manure (fresh manure favourable)
  - Homogenisation and addition of water (dry matter 25-30%)
- Application/dosage of fly egg
  - Egg density (~10,000 eggs/kg manure)
- 'Stirring' of manure
- Maintaining environmental conditions

Separation of larvae from manure - Assessment of various methods

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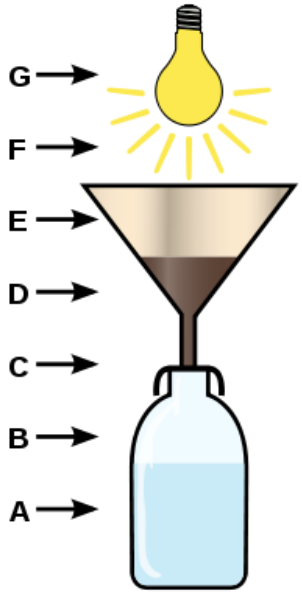
- **Flotation** (high water demand, wet compost product)
- **Sieving/screening** (not suitable for heterogeneous substrates)
- **Light** (only suitable for 'thin layered' substrates)
- **Electricity** (energy demanding and difficult to apply)
- **Hermetic enclosure** (low cost, may be difficult to apply)
- **Heat** (energy demanding, very efficient separation)



Separating manure and larvae - Heat

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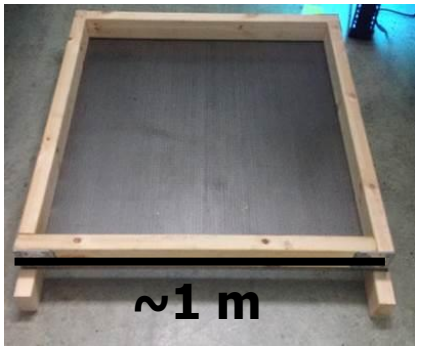
- Direct heat used for separation (heated metal lid, PID controller)
- Initiation of separation @ 50°C
- Energy consuming (estimate of 2 kWh/kg larvae)
- Scalable (Recovery 90+%, ~100% @ small scale)



Fly egg vs. Larvae production

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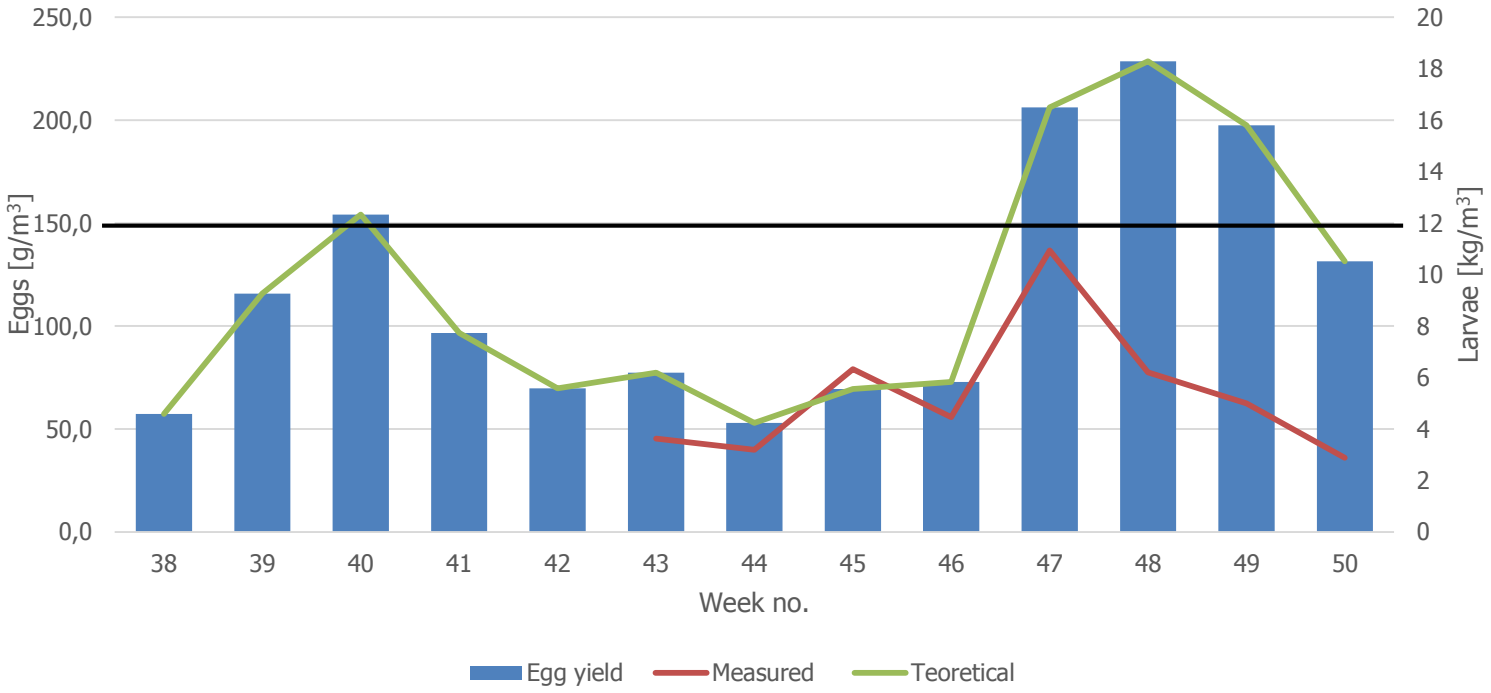

Egg yield$_{ave}$: 150 g/m^3 -> 12 kg larvae/m^3 -> 12 m^3 fly breeding area (~140 kg larvae) for sustaining the container system

Economic assessment of *Musca* larvae production

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1800 kg manure/week(1) → 55 kg larvae meal (DM)/week(2) → 145 euro/week(3) → 7200 euro/yr(4)

(1) Capacity of system, (2) FCR 8%, DM 40%, (3) 2.5 euro/kg (@2020), (4) 50 weeks/yr

- Total income ~9000 euro/yr.
- Expenses
  - Larvae rearing ~8000 euro/yr.
    - Electricity
    - Labour
    - Depreciation and maintenance
  - Fly breeding (12 m^3)
    - Labour
    - Feed
    - Shipment

~10 euro/kg fly egg

What does it take to make it fly?

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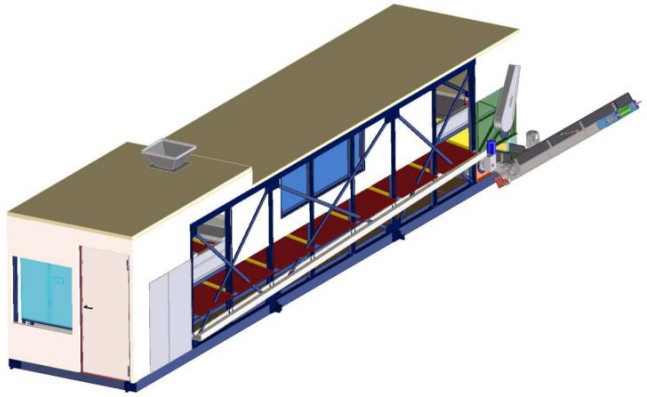
- Increasing larvae meal prize
  - Ban of fish meal for organic egg layers?
- Improving the container system
  - Lower production price of container unit
  - Optimizing automisation/processing
- Improving rearing and breeding of *Musca*
  - Improving egg survival (application of eggs)
    - Shipment conditions of fly eggs



Thank you for your attention!

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Further information on BioConVal or to discuss future insect collaborations - please contact

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