BACTERIAL HEALTH IN DUTCH INSECT CULTURE

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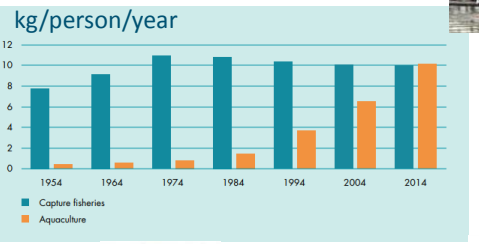
WAGENINGEN UNIVERSITY & RESEARCH has hogeschool

Fisheries and aquaculture in food (FAO, 2016)



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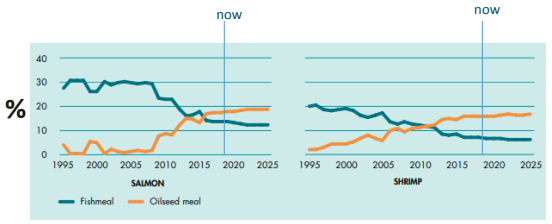
Fish meal and soy meal in aquaculture feed (FAO, 2016)... Alternative protein needed!



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… 1/3 of our food is wasted = a leftover stream

WAGENINGEN UNIVERSITY & RESEARCH Source: https://www.bakkersbaas.nl/2017/05/22/voedselverspilling-in-nederland-neemt-nauwelijks-af/

… insect culture? ...on safe left over streams...?

has hogeschool

Lectureship healthy and safe insect culture

has hogeschool

- At HAS University of Applied Sciences
- Since Jan 2018, for 4 years
- Aim: healthy and contact safe (bact) insect culture for (fish) feed and food, and BSc education

www.has.nl

INVIS

HAS University of Applied Sciences, Den Bosch: INVIS core team

Dr. Arjan Borghuis (HAS), Dr. Olga Haenen (WBVR), Dr. Ellen Weerman (HAS)

Insect farmers: 25 in 2018 now 31, and 24 pupils on course for insect farmer now

Insect species for culture

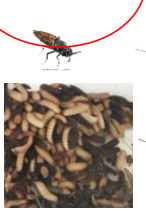
Lesser Mealworm
Alphitobius diaperinus
0,7 cm

Mealworm
Tenebrio molitor
1-2 cm

Morioworm
Zophobas morio
2,5-3cm

Insect species for culture

For feed
Black soldier fly
Hermetia illucens
2,5 cm



House and band crickets
Acheta domesticus en Gryllodes sigillatus
5 cm

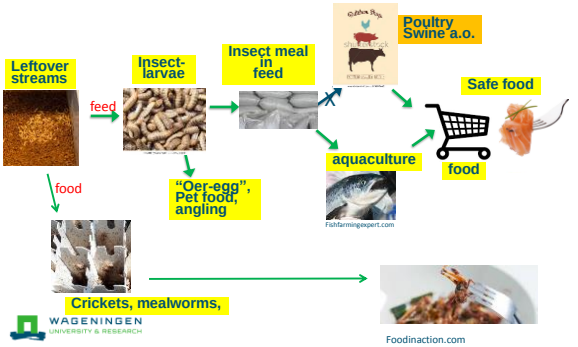
Migratory grasshopper
Locusta migratoria
10 cm

Insect farms

- Glasshouses, tunnels, mushroom cells, climate cells..
- We did our study at Kreca BV, Ermelo, NL

Photo: Kreca BV/ Proti-farm

INVIS: Analysis : the chain



Black Soldier Fly (BSF) larven

Insect meal in salmon feed: promising!

Feb 2018

Why Salmon Eating Insects Instead of Fish Is Better for Environment

Insect(meal) in fish feed: replace fish and soy meal

(Tran *et al*., 2015)

species	% protein replacement possible	remark
salmon	**100%**	Dependent on substrate
trout	25-50%	Growth a bit lower
tilapia	**high %**	Only as meal possible
catfish	25%	
turbot	33%	Defatted insect meal, problem with chitin digestion

Protifarm NV (mealworm culture)

Proti-Farm®

PROTIX

...and **Protix** BV opens huge Black Soldier Fly larvae farm for salmon feed a.o.
11 June 2019

Report Dutch Council on Animal Affairs, 2018

Analysis: Health problems in insect culture?

- Sudden, high mortalities
- Parasites, fungi, bacteria, viruses
- Mostly: Management problem...
- Copenhagen diagnostic lab (KU,prof.dr. Eilenberg)

Eilenberg et al., 2015

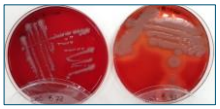
The international field

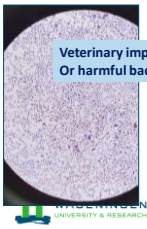
- **KU Copenhagen**, Denmark, group Prof. Eilenberg: **insect diseases**
- Thomas More Campus, **KU Leuven**, Belgium, group Prof. Van Campenhout: **food safety**
- **WU Wageningen**, NL: **insect viruses**
- **COST Insects**: resubmitted: Michelle Epstein, **Uni Vienna**, Austria, and many partners
- Interested partners: CEFAS (UK), Warmia and Mazury (Poland), Stellenbosch University (South-Africa), and Rajiv Ghandi University (India), Julius Kühn Institute (D), a.o.

WBVR, and
Dept Virology WU

Project: Bacteriology of crickets and mealworms at a farm (Babette Weller, student)

Bacteriology of crickets and mealworms





Veterinary important bacteria?
Or harmful bacteria through contact with man?

MALDI-TOF identification

Results

- Various species of bacteria were detected, mostly commensals to humans and animals
- Regarding **insect pathogenic bacteria**:
  - In the morio worms: *Bacillus pumilus, Enterobacter cloacae*, *E. kobei,* and *Klebsiella pneumoniae*
  - In the house cricket: *Lysinibacillus sphaericus* was detected in its drinking water
- Some of the commensal bacteria may turn zoonotic in rare cases, only when humans are strongly immunocompromised.

Literature search, scarce on **insect diseases** (other than from viruses): **some bacteria:** pathogenic?

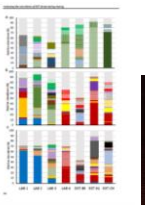
- *Aeromonas* spp.
- *Serratia liquefaciens*
- *Serratia marcescens*
- *Acinetobacter baumannii*
- *Lactobacillus antri*
- *Lactococcus formosensis*
- *Staphylococcus arlettae*
- *Buttiauxella agrestis*
- *Pseudomonas aeruginosa*
- ***Rickettsiola* spp.**

Klebsiella, *Enterococcus, Providencia, Alcaligenes, Cirrobacter, Pseudomonas, Bacillus Sphingobacterium, Morganella, Ochrobactrum, Acinetobacter, Paenalcaligenes, Miniimonas, Paenochrobactrum, Cronobacter, Verrucomicrobia*

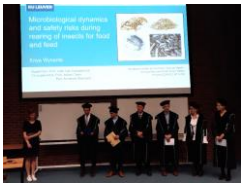
Pseudomonas aeruginosa
Bacilus thuringiensis
Bacilus amyloliquefaciens
Bacillus cereus
Bacillus laterosporus
Bacillus licheniformis
Bacillus megaterium
Bacillus pumilus
Bacillus subtilis

→ No primary fish pathogens seen

Microbial community in mealworms for **food**:



Stoops *et al.*, 2016



PhD defence **Dr. Enya Wynants**, KU Louvain, Belgium, 16 May 2019

High throughput gene amplicon sequencing:

Relative abundance of Operational Taxonomic Units (OTUs) of >5% (thesis), mainly *Morganella*

Conclusions

- No alarming results regarding bacteria in this pilot study at this farm, given the fact, that standard hygiene measures are practiced to prevent for infections
- However, further testing is needed on presence of veterinary and contact zoonotic bacteria: in time and at various farms
- Still much to discover in many small new farms
- Which NRL would be interested in international cooperation?

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