ADVISORY COMMITTEE ON ANIMAL FEEDINGSTUFFS

71st Meeting of ACAF on 27 October 2016

Presentation Paper

Insect protein as a potential animal feed

Elaine Fitches
Durham University
October 2016

Insects as an Animal FeedStuff

Durham University

ACAF 27th October 2016

Elaine Fitches

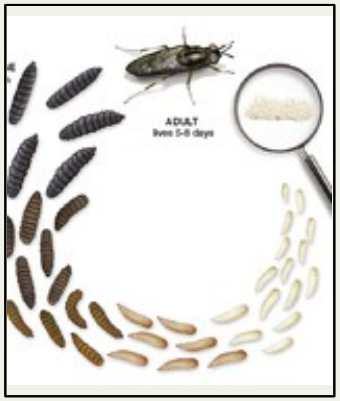
To cover:

- Background
- Research outcomes:
  - EU PROteINSECT
  - TSB Innovate
- Commercial activities

Why Insects ?

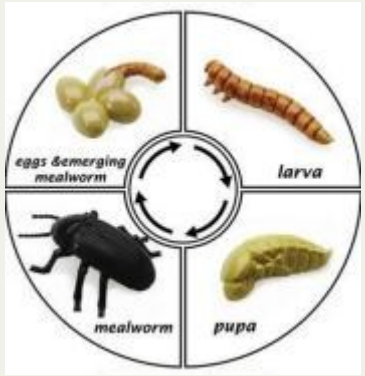
- Insects **highly efficient** in the **rapid** conversion of “waste” into biomass
- A **natural** component of the diets of carnivorous fish and free-range poultry
- **Protein levels** in insect meals 55-75 %, comparable to animal protein sources
- Protein **digestibility** (86-89%) higher than many vegetable based proteins

Which Insects ?



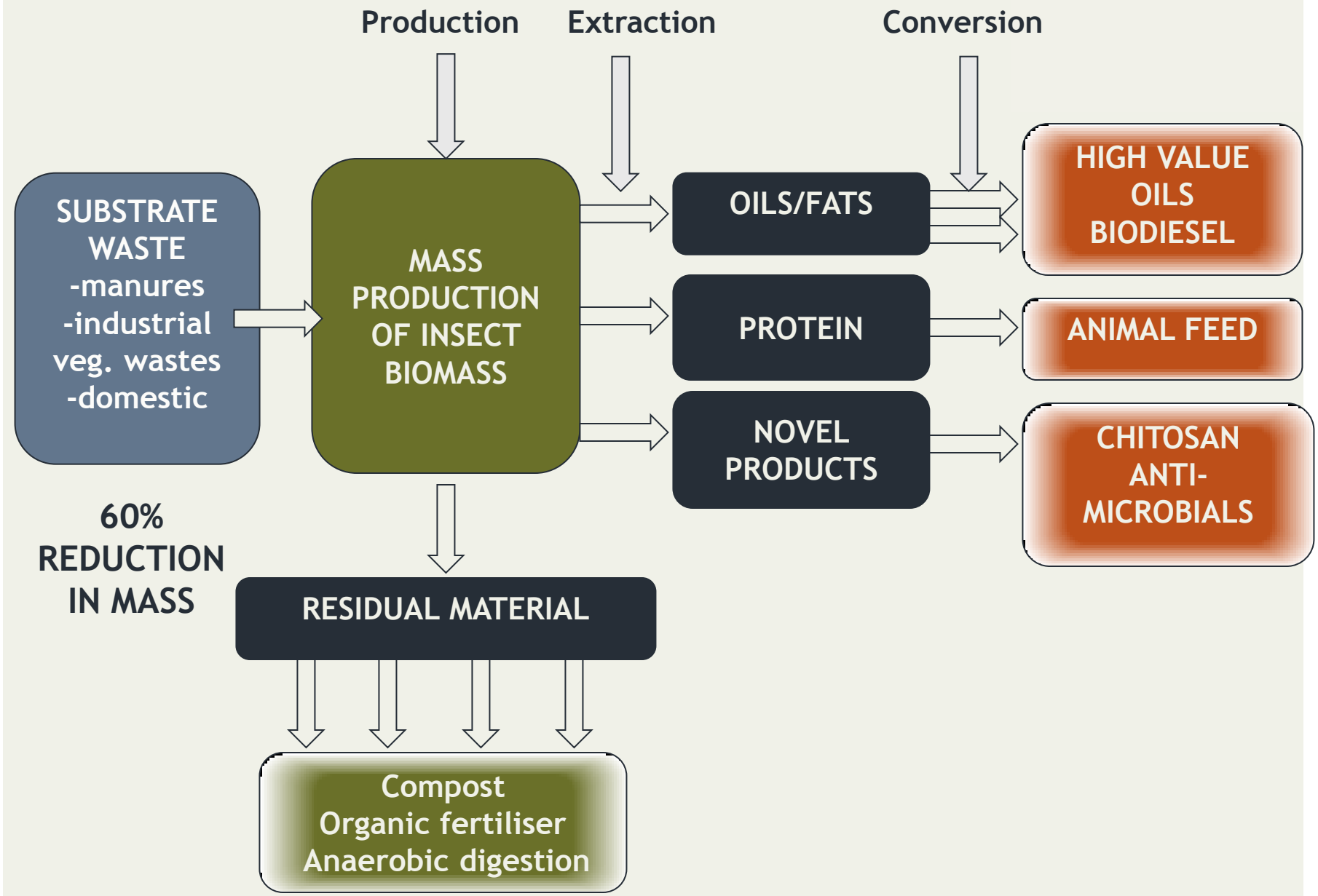
Dipteran larvae

- vegetable, swine & poultry waste
- min. 14 days: egg to mature larvae
- require > 30 °C for development
- mean wt. 0.2 g/ larvae



Coleopteran larvae

- wheat bran & vegetable waste
- 8-10 weeks: egg to mature larvae
- require ~ 25°C for development
- mean wt 0.14 g/ mature larvae


Production
Extraction
Conversion
SUBSTRATE WASTE -manures -industrial veg. wastes -domestic
MASS PRODUCTION OF INSECT BIOMASS
OILS/FATS
PROTEIN
NOVEL PRODUCTS
HIGH VALUE OILS BIODIESEL
ANIMAL FEED
CHITOSAN ANTI-MICROBIALS
60% REDUCTION IN MASS
RESIDUAL MATERIAL
Compost
Organic fertiliser
Anaerobic digestion

Alternative protein production technology for animal feed (2012- 2015)

Aims

- Identify a new, sustainable protein for incorporation into monogastric feeds **(housefly larvae)**
- Produce high quality protein from low value organic materials whilst monitoring feed safety
- Examine the commercial potential for the optimised production of insect larvae

Technology Strategy Board
Driving Innovation

ab agri
Associated British Agriculture

fera

PROteINSECT
INSECTS AS A SUSTAINABLE SOURCE OF PROTEIN
www.proteinsect.eu

- 3-year EU-funded project (2013-2016) with 12 partners from 7 countries (China, Africa, Europe)
- Focus on the use of **fly larvae (housefly & BSF)** in poultry, pig & fish feed
- Evaluating the suitability of **organic waste materials**, including animal manure, as a substrate for rearing flies.

nutrition sciences
cabi.org
IER
Guangdong Entomological Institute 广东省昆虫研究所
fera
1898
THE FISH FOR AFRICA FUND POISSON POUR L'AFRIQUE
Minerva
UNIVERSITY of STIRLING
eu|te|ma TECHNOLOGY MANAGEMENT
GRANT BAIT Ltd The Fresh Bait Experts
KU LEUVEN

- Substrates- animal manures
- Low value wastes
- Insect rearing systems (China, Africa, UK)

- Nutritional value & quality
- Safety (Chemical & Biological)
- By-product evaluation

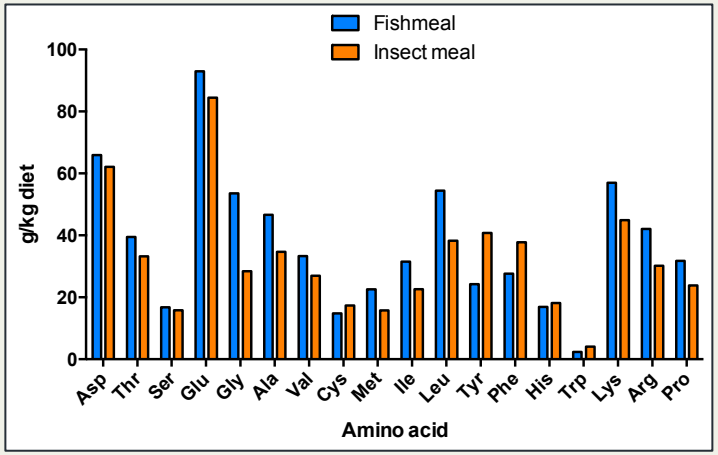
- Processing- crude & refined protein

- Regulation
- Consumer perception

- Animal trials
- Inclusion rates
- Meat quality

Quality & Biological Safety

- Amino acid profile comparable to fishmeal & fatty acids comparable to palm kernal oil (high in lauric acid)
- A developed processing method (based on Method 7, ABP regulations) is suitable for drying larval material and mitigates potential microbiological issues
- Hexane extraction is a suitable, scaleable method to produce protein enriched (mean 51% to 68% [w/w]) material



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abagri

Chemical Safety

Screen for 492 agrochemicals

68 Veterinary medicines

393 Pesticides

69 Mycotoxins

28 Polychlorinated biphenols (PCBs)

48 Heavy metals/trace elements

42 Dioxins/Polychlorinated hydrocarbons (PAHs)

Contaminants below recommended max. concentrations (EC, WHO, & Codex)

- **Cadmium high in 3 samples**
- **Contributed to EFSA expert opinion 2015**

Exploring the chemical safety of fly larvae as a source of protein for animal feed

A.J. Charlton, M. Dickinson, M.E. Wakefield, E. Fitches, M. Kenis, R. Han, F. Zhu, N. Kone, M. Grant, E. Devic, G. Bruggeman, R. Prior and R. Smith

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Aquaculture- feeding trials

Ghana: Nile Tilapia fingerlings
Black soldier fly meal (MM)

Commercial conditions

- Treatments: FM100; MM25, 50, 75% replacement of FM
- 22, 500 fingerlings, (1 m^2 cages, 1500 fingerlings per cage, triplicate), 32 days
- Hand feeding (experienced operator)

Results

- All dietary treatments performed well & similarly to control fishmeal diet
- Fish oil-free diets impacted on the fish composition (reduced in omega 3)- to consider for further application to grow-out fish

UK: Atlantic salmon freshwater parr: housefly meal (MM) and de-fatted meal (DMM)

Freshwater Research Unit

- Treatments: FM100; MM25, 50, 75, 100 % replacement of FM; 50% replacement of FM with DMM
- 3,600 parr, 18 tanks (1 $m^{3;}$ 200 fish/tank), triplicate, belt-feeder, 8 weeks

Results

- MM & DMM suitable alternative to FM – **can replace up to 50% FM** in a practical diet for parr
- A good source of highly digestible protein (amino acid profile, digestibility)
- Lipid digestibility was reduced when up to 75% or more FM was replaced by MM or DMM

Pig- feeding trial

Nutrition Sciences

- Treatments: control, MM 2.0 % & DMM 1.25 % w/w (replacing fishmeal)
- 48 male castrated 3 week old pigs (12 pens, 4 pigs per pen, 16 per treatment), 4 weeks
- Diets iso-nitrogenous & energetic

Results

- All treatments performed similarly well (WG,FI,FCR)
- Significantly more +ve bacteria (lactic acid bacteria) detected in the ileum of piglets receiving insect-supplemented diets.
- No taints detected in pig meat

Poultry- feeding trials

Nutrition Sciences

- Treatments: control, MM 2.0 % & DMM 1.25 % w/w (mainly replacing soybean meal & oil)
- 300 male day-old Ross 308 chicks (15 pens, 20 chicks per pen, 5 per treatment), 39 days
- Diets iso-nitrogenous & energetic

Results

- All treatments performed similarly well (WG,FI,FCR)
- Significantly less pathogenic bacteria (coliforms, *Enterbacteriaceae*) detectable in gizzard of chickens fed insect-supplemented diets
- No taints detected in chicken meat

Other poultry trials

Broiler breeder trial China

Layer trial Mali

Broiler trial Mali

Broiler Chick Digestibility Study

Full fat (oven) dried housefly larval meal vs commercial Fishmeal

Treatments:

- 20, 40 & 60 % inclusion rates (as-fed) of Fishmeal (FM) or Insect meal (IM). Semi-synthetic diet (extrapolation method)
- 6 replicate pens per inclusion level (4 birds per replicate; total 144)
- Ross 308 chicks placed at day old; day 21 birds fed expt. diets
- Day 28 birds were culled and gut contents analysed
- Pen faeces also collected for analysis

Results

- Birds performed as well on IM as on FM diets (i.e. BWG, FI, FCR)
- AME and AMEn both significantly higher for IM than FM
- True CoD of digestibility similar for IM (0.890) & FM (0.904)

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Consumer Perception

Challenges

- Lack of cultural history of entomophagy in the west.
- Negative perception; insects as pests/vectors of disease.
- Consumers increasingly interested in how their food is produced and want to be sure that it's what it says on the tin!

Two Consumer Perception Surveys

Survey 1: Baseline exercise to discover whether people would be accepting of insects in animal feed and food – and if not, what objections they raised.

Survey 2: To gain a better understanding of current consumer perceptions about eating animals fed on existing and novel proteins (insects benchmarked against current sources of protein for animal feed)

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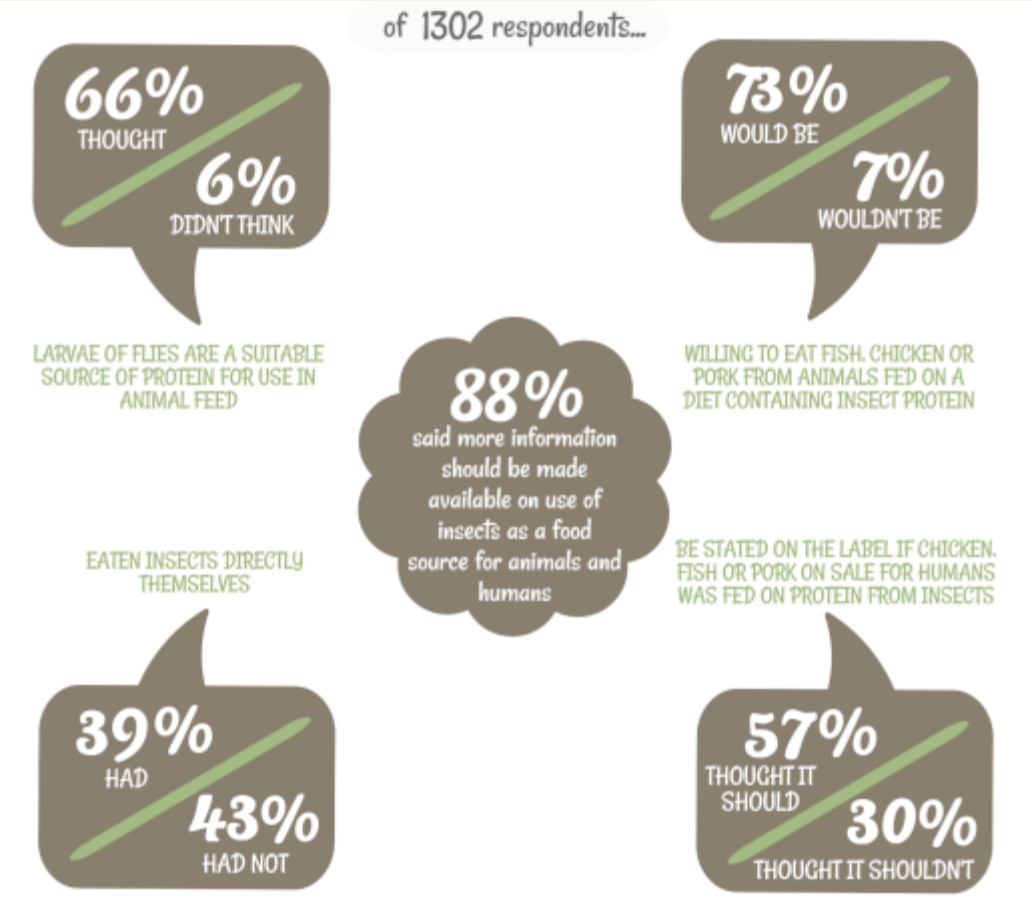
Survey 1



- People more accepting of the idea of insects in food and feed than we might have predicted
- Clear desire for more information to be made available

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Survey 2

of 1150 respondents...

ACCEPTABILITY

70%

SAID THAT IT IS TOTALLY ACCEPTABLE/ACCEPTABLE TO FEED INSECT PROTEIN TO FARMED ANIMALS, INCLUDING FISH

COMFORT

66%

WOULD BE VERY COMFORTABLE/COMFORTABLE EATING MEAT FROM A FARMED ANIMAL (INCLUDING FISH) FED ON INSECT MEAL

RISK TO HEALTH

64%

SAID THERE IS NO RISK OR LOW RISK TO HUMAN HEALTH IN EATING FARMED ANIMALS (INCLUDING FISH) FED ON INSECT MEAL

KNOWLEDGE GAP

30%

THE DIFFERENCE BETWEEN HOW KNOWLEGABLE THEY ARE, AND HOW KNOWLEGABLE THEY FEEL THEY SHOULD BE

Summary – Research Findings

- Housefly & Black Soldier fly larvae can be reared on manures and by-products: systems established across different global locations
- Nutritional quality of larvae excellent (comparable to fishmeal)
- Extensive safety screening suggests minimal risks and that potential risks can be mitigated by processing (eg. microbes)
- Fish, chicken and pig feeding trials all suggest insect meal and/or refined insect protein is a suitable replacement for fishmeal and/or soymeal
- Consumer perception & media monitoring suggest a high level of support for use of insects in animal feed but also a desire for more information

What’s happening commercially ?

‘International Platform of Insects for Food & Feed’ (IPIFF)

- Formally established 2015 -Is growing in size!
- Promoting insects as a source of animal proteins for food & feed
- Developing shared standards & best practices
- Solely focused on using vegetable waste as rearing substrates

PROFESSIONALIZING THE INDUSTRY

From “hobby” style

to industrial scale & process control

Insect derived products for animal feed are on the market

AllAboutFeed

New proteins

Background *22 Jul 2016* 8166 views 2 comments

Canadian firm approved to use insects for feed

Enterra Feed Corporation has received regulatory approval for use of its Whole Dried Black Soldier Fly Larvae as a feed ingredient for poultry broilers.

Enterra

Piglets

News *Oct 4, 2016* 752 views *last update:Oct 7, 2016*

A novelty: Insect oil in piglet feed

Insect oil is forming the basis of a new feed ingredient for weaner pigs – according to the manufacturers it's a world's first.

The weaner feed with the insect ingredient has potential to reduce bacteria, prevent diarrhoea and improve feed intake, stated animal nutrition Coppens Animal Feed and P rotix in an interview with *Pig Progress*' sister title *All About Feed*.

Protix is producer of insect oil and insect protein. The company is supplying the ingredient to Coppens, which further processes the components into a commercial pelleted feed in their feed mill in Helmond, the Netherlands.

Alternative Protein Consortium

Science, technology & capital for scale-up

- Founded by AEI (developer & financer of projects in food, water & energy security) www.aeihk.com
- 12 breeding facilities for ongoing research & trials
- Over 500,000 tonnes per year of quality organic substrate secured in SE Asian market for multiple Insect Bioreactors (IBRs); licensed & approved by government agencies
- Focus on the tropics (ideal year round climate = energy efficiency & abundance of ready-existing substrate)
- Off-grid concentrated solar power for climate control
- Proprietary IBR modules for '*bolt-on*' applications (substrate received from palm oil mills, sugar mills, breweries etc)
- Replicable across target countries in SE Asia, Africa, S. America

Insect Bio-Reactor (IBR): Module & process

Module is "bolted on" to back ends of:
palm oil plants, breweries, coffee mills, wheat and rice mills, copra, fruit, sugar-cane processing plants, etc

IBR Module #1 (40,000 tpa feedstock / substrate)

1a/1b. Pre-preparation and drying — Air drying/ desiccant heating of raw substrate

2. Milling and storage — Storage of dried raw substrate

3. Preparation of feed — Preparation of feed for larvae (milling/crushing/ fermentation)

4. Farming of larvae — CSP heated climate chamber. Separate chamber for breeding and eggs

Liquids & solids from BSF — Drying/bacteria

Larvae pre-processing — Drying/freezing/ heating etc

6

7. Processed end products
- *Bio-fertilizers*
- *Additives*
- *Proteins*
- *Acids*
- *Lipids*

5. All energy and solar thermal requirements met by Aalborg CSP

Committed to industrial scale production of safe, traceable, quality insect products for global markets

7 Final processed higher-end products

Insects	Whole	Pet food, animal feed, Human Food
	Protein	Pet food, animal feed, human food, nutraceutical
	Fats	Pet food, animal feed, nutraceutical, pharmaceutical
	Chitin	Nutraceutical, pharmaceutical, animal feed
	Lauric Acids	Nutraceutical, pharmaceutical, cosmetics
Waste Residue		Bio-fertilizer, bacteria strata, shrimp feed

Thanks to:

All PROteINSECT partners

Michael Dickinson
Maureen Wakefield
Katherine Robinson
Damian De Marzo
Howard Bell

Heidi Hall
John Sissins
Angela Booth

David Carew
& the apc
Cons.

Project Co-funded by Innovate UK Technology Strategy Board