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Australian Export Grains Innovation Centre

Barley & Aquaculture
Beer, bugs & sustainability

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Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

AEGIC is an initiative of the Western Australian State Government and Australia's Grains Research and Development Corporation

Scene setting

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Why Asia

Philippines
Vietnam
Thailand
Malaysia
Singapore
China

Population density
> 2 Billion people
Climate
- Perfect for bugs
- Perfect for beer drinking

Low cost of production
- Reasonable labour inputs needed

Proximity
- Huge Aquaculture industry

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An exciting story about a brighter future

Sustainability

Making more from less

Nutritional value

High value protein source

Excellent palatant

Functional value

Immune benefits

Reduced reliance on antibiotics

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Joining the dots

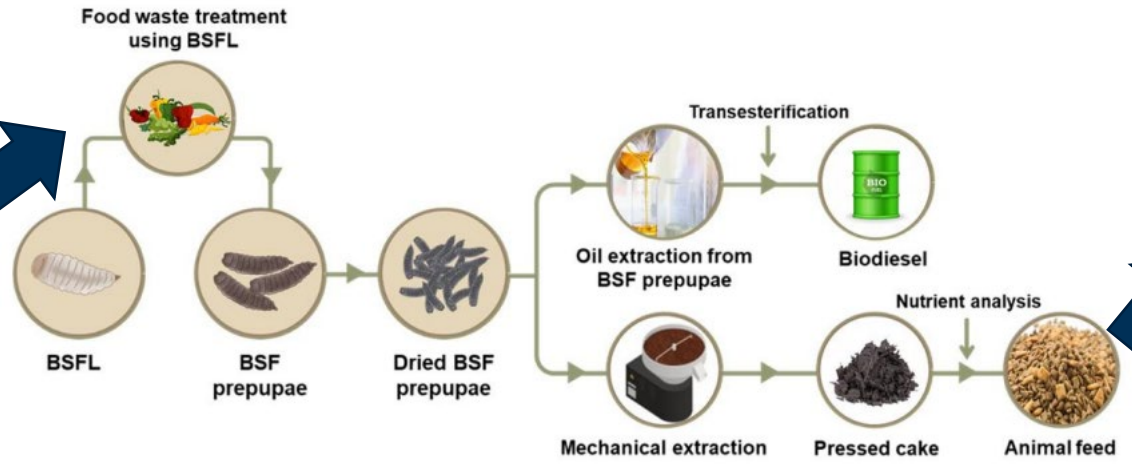

Figure 3. Process of food waste treatment using BSFL and production of biodiesel and animal feed from BSF (modified from [68]).

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Sustainability

An environmental challenge

>5MMT of Fishmeal

Depletion of marine resources

Aquaculture industry seeking alternatives

Insects offer a solution

Natural food source for fish and poultry

Rapid and efficient bio-converters

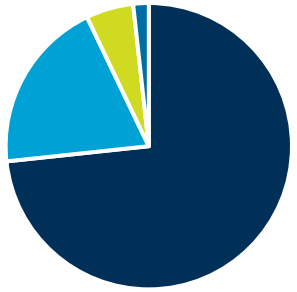
Can help utilize waste products and co-products. Lower CHO emmisions

Low land requirement for production.

Beer is the 5th most consumed drink

>2 Billion hL produced globally

Waste products from brewing are excellent food substrates for BSFL



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The package

- Protein meal

- Insect oil
  - Tastes like macadamia nuts
  - Can be used in pig and poultry diets to replace other fat sources
  - Rich in lauric acid (MCFA – fuel for liver)
  - Could have applications in bio-fuels

- Chitin/chitosan
  - Naturally occurring polymer with wide range of applications
    - E.g. Biomedical applications for wound healing
    - E.g. Antibacterial packaging for food

- Antimicrobial peptides
  - Produces over 50 different kinds
  - Provides immune benefits

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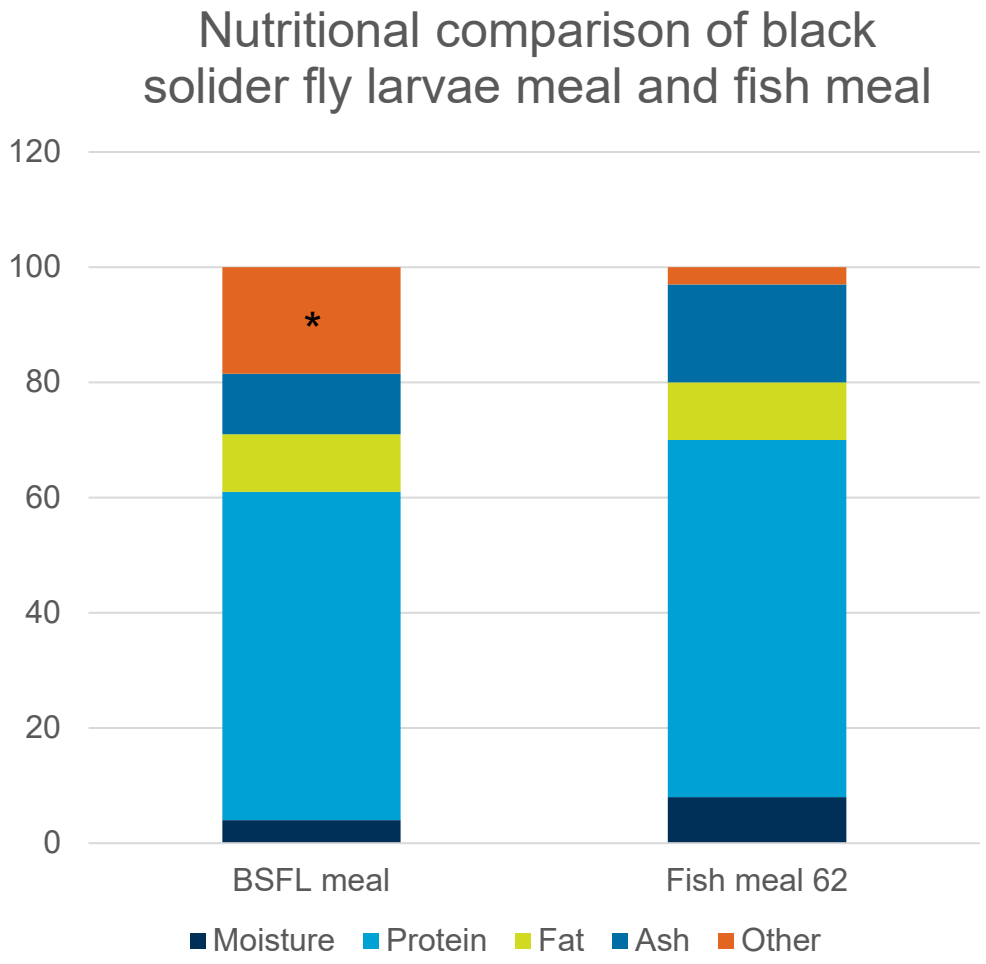
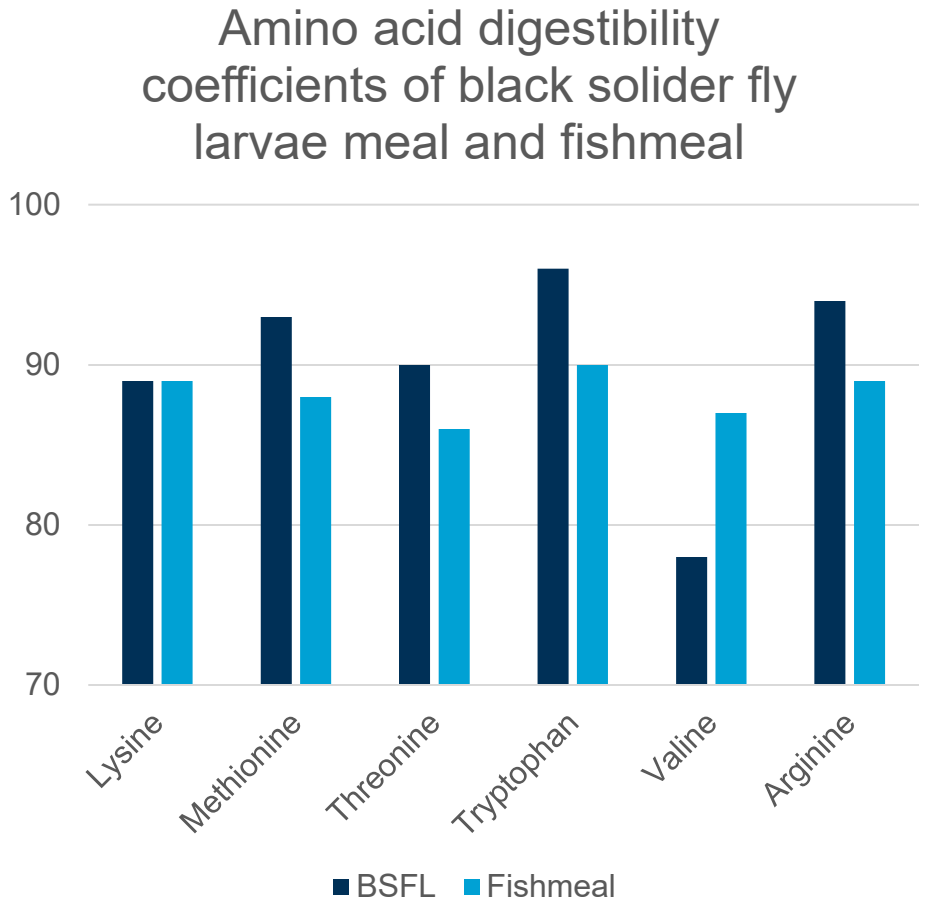
Nutritional value





* Black solider fly larvae contain about 5-6% chitin
Marine species can tolerate up to 1% chitin in their diet

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Fish trial

Li et al 2022
Species of fish : Tongue sole

	Control	BSFL	
Fishmeal %	50	37.5	25% reduction
Defatted Black solider fly meal %	0	14.41	
Weight gain rate %	31.86	35.84	12.5% improvement
FI %/d	2.12	2.12	
Feed conversion ratio (Feed:Gain)	1.26	1.14	9.5% reduction
Survival rate	95	100	

Key Finding:
BSFL can replace up to 25% of the fishmeal in the diets of Tongue sole.
Performance can be improved.

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Shrimp trial

Wang et al 2021
Species of shrimp : L. vannamei (pacific white shrimp)

	Control	BSFL	
Fishmeal %	25	13.75	45% reduction
Defatted Black solider fly meal %	0	17.62	
Final Body weight g	14.1	15.3	8.5% improvement
FI g/shrimp	17.3	17.1	
Feed conversion ratio (Feed:Gain)	1.2	1.1	8.3% reduction
Survival rate	86.9	87.3	

Key Finding:
BSFL can replace up to 45% of the fishmeal in the diets of pacific white shrimp
Performance can be improved.

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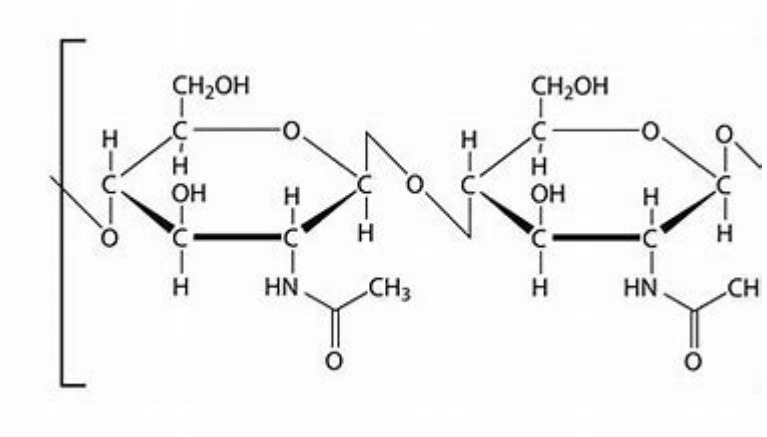
Why do we get better performance?

Chitin/Chitosan

- At low dose is an immunemodulator
  - Fish can tolerate up to 1% Chitin in there diets
  - Insect meal contains 5-6% Chitin
  - So we could use up to 20% of BSFL meal in the diets
- At high dose it impairs digestion and absorption of nutrients
- Poultry and fish have Chitinase enzymes
  - Allows for systemic benefits of chitin beyond GIT
- Known benefits of Chitin/Chitosan
  - Antioxidant
  - Anti-inflammatory
  - Anti-tumor
  - Anti-cancer
  - Enhance vaccine efficacy

Chitin – 2nd most abundant polysaccharide after cellulose



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Why do we get better performance?

Antimicrobial peptides

- Alternative to traditional antibiotics
- Potential to reduce antibiotic resistance
- Potential to reduce to impact of superbugs for humans (MRSA)
- Potential to improve animal health and productivity

- Black solider flys produce more than 50 AMPs
  - Highest number found in any known living organism except for the Harlequin (ladybug)
  - Choose to feed in high pathogen environments
  - Provides immune defence and helps to shape the microbiota within there gut

- Examples of AMPs families
  - Defensin
  - Cecropin

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Opportunities to exploit functional value

Early days, but watch this space

Extraction and purification of the functional components

- Specialised companies
- Human and animal health applications

Dietary manipulation of AMP expression

Disease specific approach

- Similar to vaccine development idea
- Exposure of pathogen to BSF to excrete the most effective repertoire of AMP for a given disease
  - Vibrio disease in shrimp
    - Up to 100% fatality rate

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Economics

Fishmeal will likely become more scarce and more expensive

- Price ranges from $1500 to $2500/T
  - Depends on quality, supply, location etc

Black solider fly meal needs to be competitive

- Nutritional value is not as strong as fishmeal but is better than meat and bone meal, poultry by-products, etc
- Functional value is superior to fishmeal, and with further manipulation could be more valuable

As BSFL farming develops and scales up the cost of production will fall, and the ability to be competitive will grow.

Early adopters are willing to pay the same price as premium fishmeal

- Inclusion rates are modest, but it creates branding opportunities
- High value species most likely target whilst price is high

Concluding remarks

We have a lot to learn before we can optimise the value of black solider fly farming

I’m excited to be apart of the journey towards a brighter future

Australian barley producers can have a positive impact on

- Sustainability
- Nutrient upcycling
- Human and animal health
- Environment

Sit tight, grow more barley, drink more beer & watch this space….

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Thank you for listening

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