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LEADING A REVOLUTION IN BIOWASTE RECYCLING

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Extraction, characterization and functional properties of proteins from black soldier fly larvae (BSFL) reared on canteen waste

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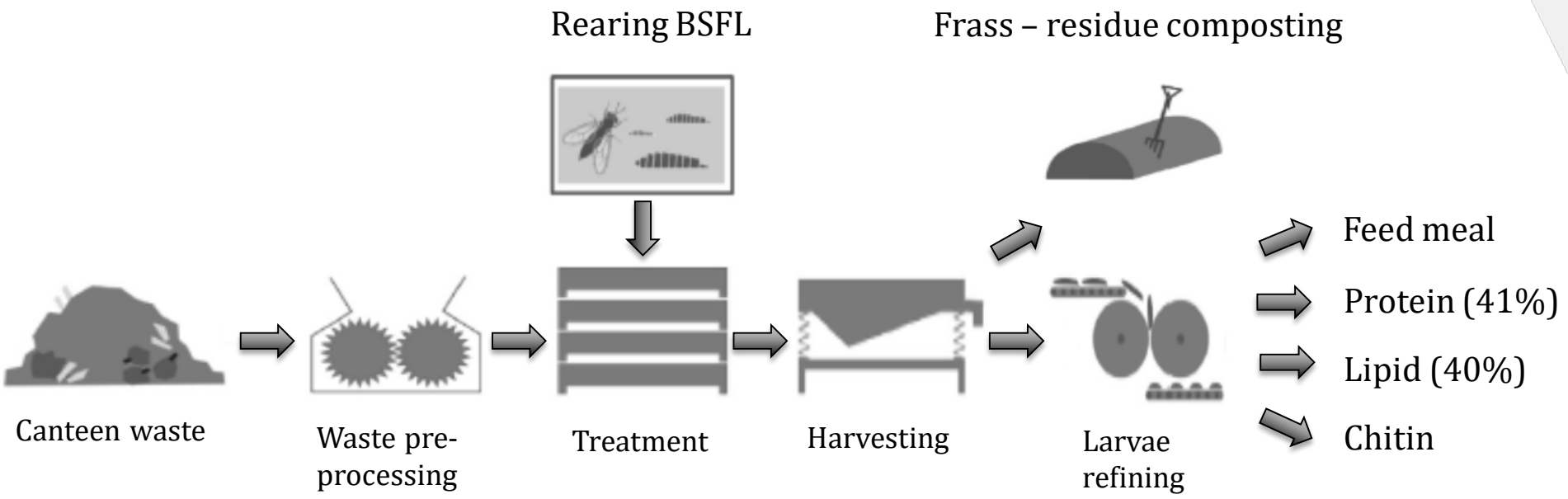
Content

- Rearing of insects (BSFL) on canteen waste
- Issues
- Protein extraction
- Amino acid profile
- Techno-functionalities of BSFL proteins
- Application of BSFL in dog food
- Conclusions

Rearing of insects (BSFL) on organic waste

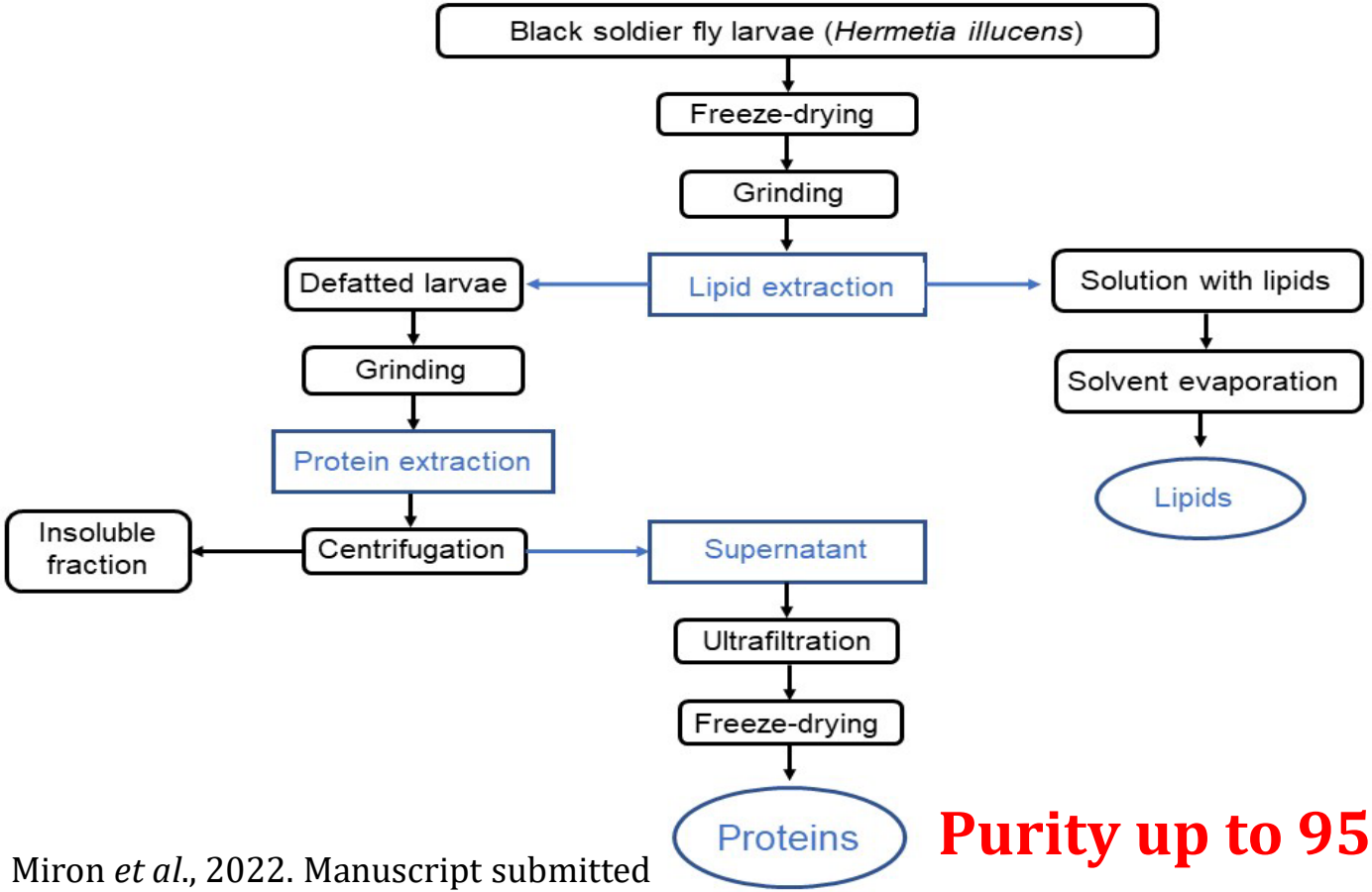


Issues

- The use of insect meal as feed and food is limited by the **legislation in Europe**
  - Novel Food according to the guidelines for market authorization of products by EFSA
  - Documents of safety demonstration of certain insect

- **Consumer acceptance** - the largest barrier to the adoption of insects as viable sources of protein in many Western countries

Protein extraction



Purity up to 95%

Miron *et al.*, 2022. Manuscript submitted

Amino acid profile

Amino acid	Amount in BSFI (mg/g protein)	Human requirements (mg/g protein)
His	27.0 ± 3.55	15
Ile	46.6 ± 5.11	30
Leu	70.4 ± 7.7	59
Lys	73.2 ± 8.1	45
Met	24.8 ± 3.2	22
Cys	5.70 ± 0.7	-
Tyr	73.8 ± 8.1	38
Phe	53.9 ± 5.9	-
Val	51.3 ± 5.6	39
Trp	14 ± 0	6
Thr	39.9 ± 4.4	23
Ser	32.9 ± 0.1	-
Asx	116.0 ± 11.6	-
Glx	101.0 ± 11.1	-
Gly	39.0 ± 4.3	-
Ala	38.1 ± 4.2	-
Pro	35.1 ± 3.9	-

$$EAAI = \sqrt[9]{\frac{g\ of\ essential\ amino\ acid\ in\ 1\ g\ of\ BSFI}{g\ of\ essential\ amino\ acid\ needed\ in\ 1\ g\ of\ protein}} *$$

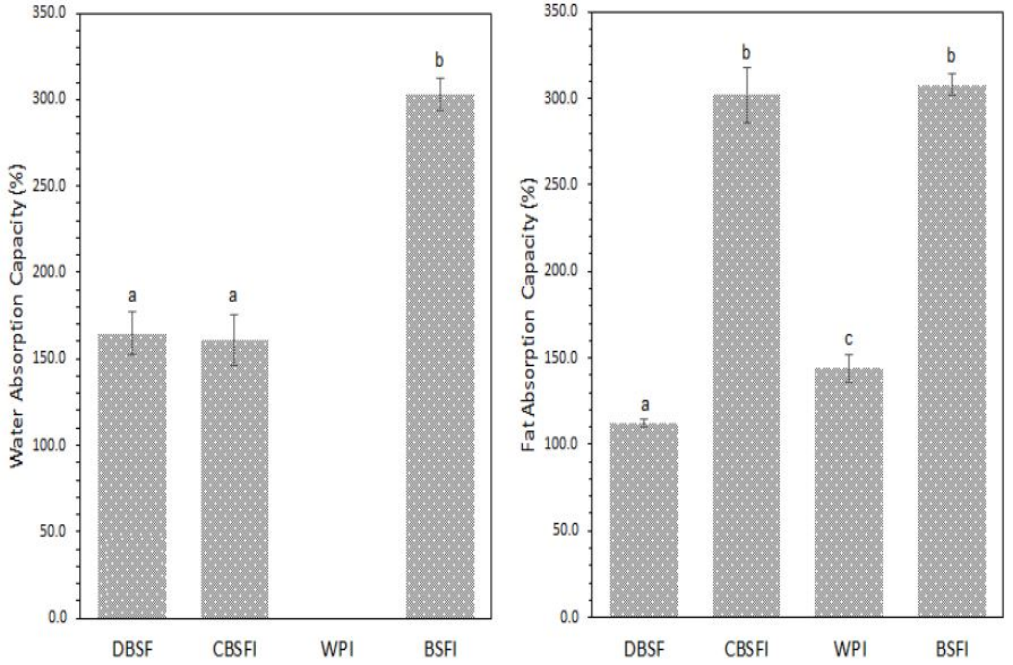
$(etc.\ for\ the\ other\ 8\ essential\ amino\ acids)$

Other proteins:

- *T. molitor,* EAAI=1.60
- *Z. morio,* EAAI=1.66
- Pea, EAAI = 1.37
- Bean, EAAI = 1.34
- Soybean, EAAI= 1.56 – 1.85
- Casein, EAAI=1.93

Techno -functionalities of BSFL proteins

	Techno-functional property	Food system
High solubility	Solubility	Beverages
	Emulsification	Sausages, sauces, soups, cakes, salad dressings, ice-cream, yogurt
	Foaming	Whipped toppings, desserts, cakes
	Gelation	Meats, curds, cheese, meat analogues
Intermediate solubility	Cohesions-adhesion	Meats, sausages, baked goods, pasta
	Elasticity	Meats, bakery, cheese
	Viscosity	Soups, gravies, low-fat products
Low solubility	Fat adsorption	Meats, sausages, cakes, bakery
	Flavour binding	Meat analogues, bakery
	Hydrophobic films	Food coatings



- Defatted larvae (DBSF),
- Commerical BSF protein isolate (CBSFI)
- Organic waste BSF protein isolate (BSFI) and
- Whey protein isolate (WPI)

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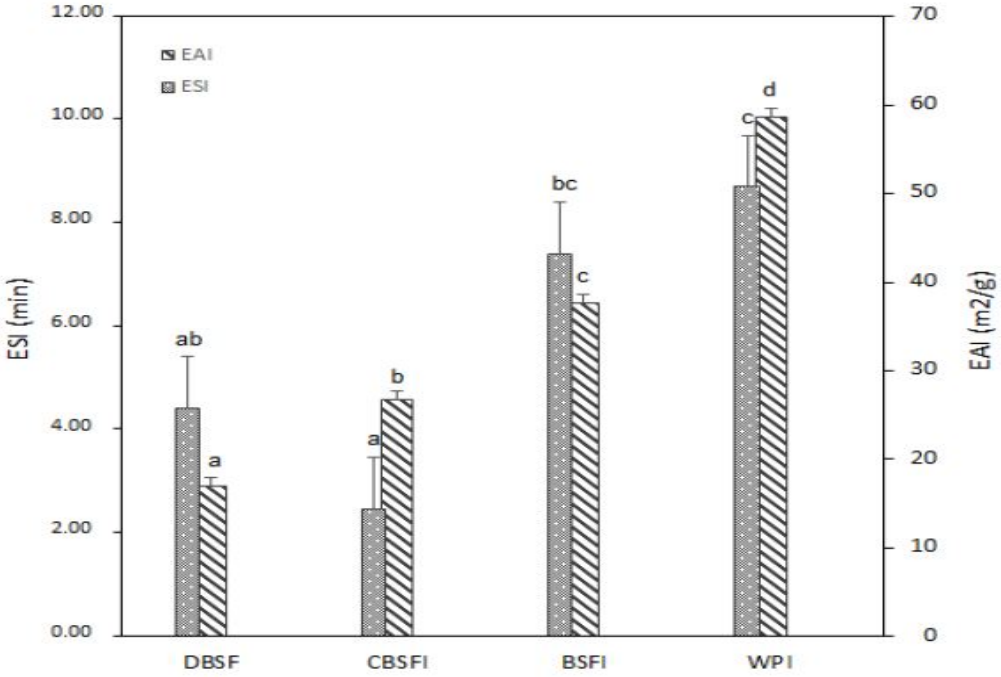

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Application of BSFL in dog food

- Dog food formulation used for extrusion

Raw material	Composition without insect (%)	Composition with insect (%)
Rice flower	50	50
Poultry meal	19	15
Greaves's meal	8	5
Brewer's yeast	15	15
Rapeseed oil	5	
Bone meal	1	
Premix	2	2
BSFL		13

Application of BSFL in dog food

❑ Extrusion trial

APV Baker extruder used for producing dog food kibbles

PARAMETER	SETTING 1	SETTING 2
FEEDER (RPM) (OR%)	20	20
SCREW (%)	40	40
KNIFE (RPM)	100	100
WATER PUMP STAND (L/H)	12	12
DIE OPENING	2x3.5	2x3.5
TEMP ZONE 1 (°C)	30	30
TEMP ZONE 2 (°C)	40	40
TEMP ZONE 3 (°C)	50	50
TEMP ZONE 4 (°C)	60	60
TEMP ZONE 5 (°C)	80	100
TEMP ZONE 6 (°C)	105	125
TEMP ZONE 7 (°C)	120	140
TEMP ZONE 8 (°C)	125	145
TEMP ZONE 9 (°C)	130	150

Application of BSFL in dog food

- Dog food kibbles

Conventional (130 °C)

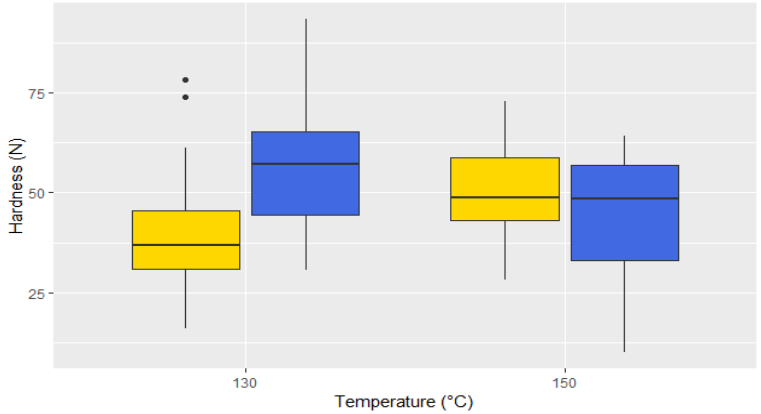
With insects (130 °C)

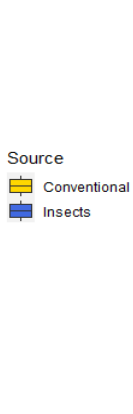
Conventional (150 °C)

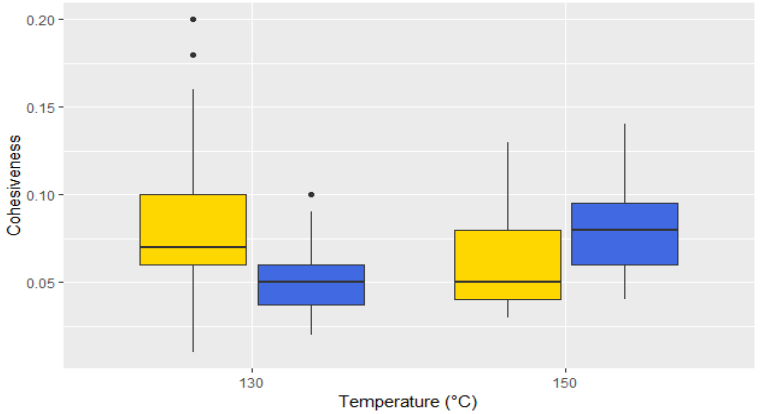
With insects (150 °C)

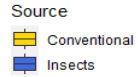
Application of BSFL in dog food

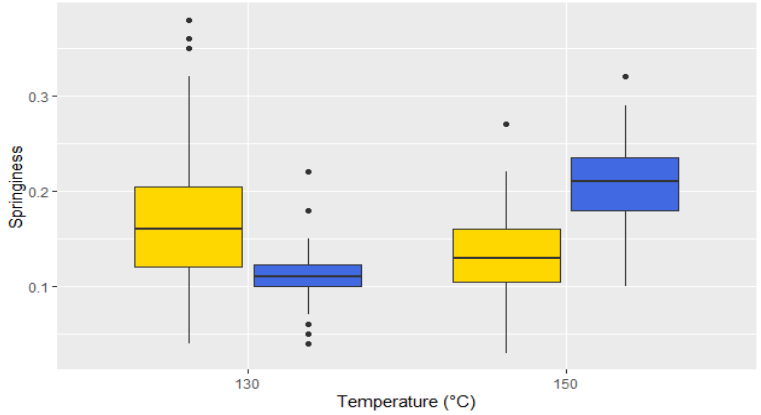
- Texture

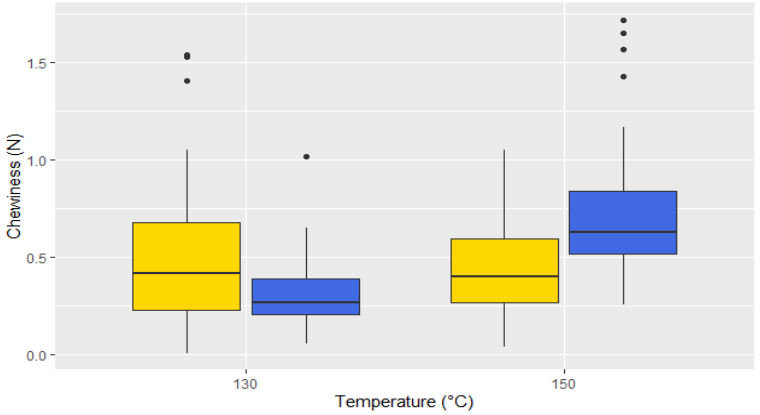






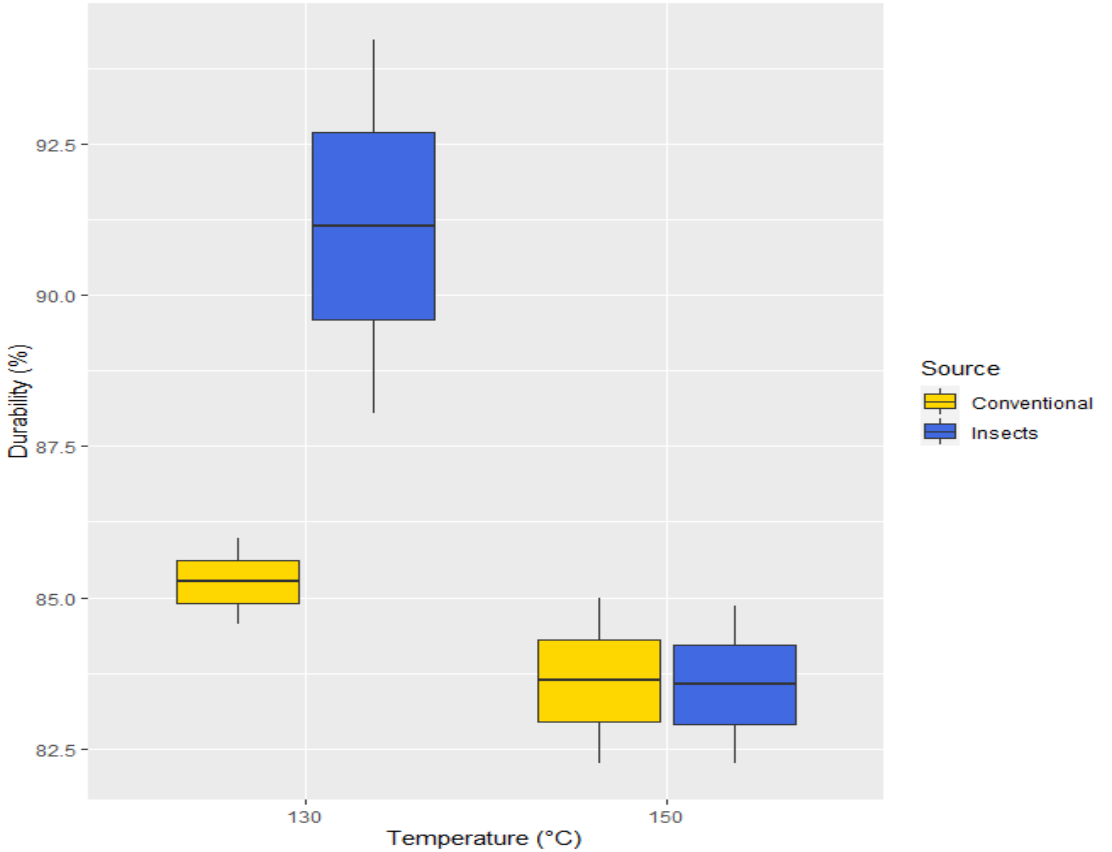






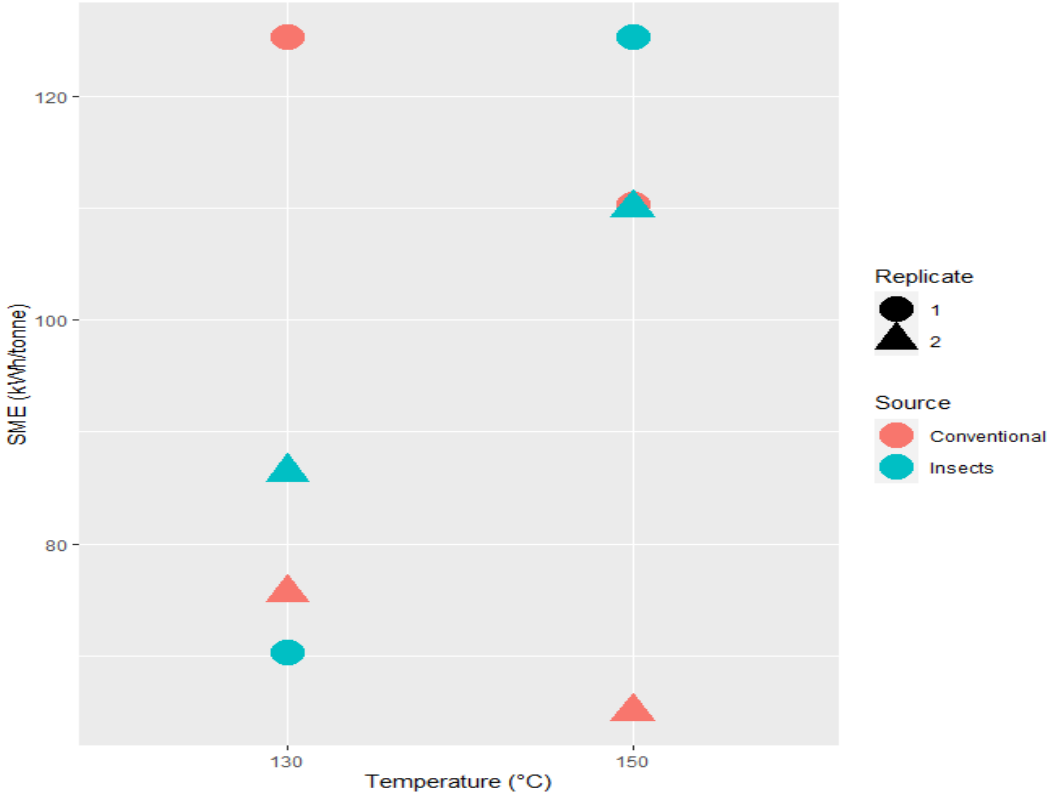
Application of BSFL in dog food

- Pellet Durability Index (PDI)



Application of BSFL in dog food

- Energy consumption – SME (kWh/tonne)



Conclusions

- Insects can be a sustainable source of proteins
- Legislation and consumer acceptance are the main issues for scaling up insect production
- BSFL proteins show good fat binding capacity and emulsification activity
- BSFL can successfully replace conventional sources of proteins and oils in dog food kibbles.
- BSFL does not have any influence on the texture and energy consumption (KWh/tonne) of dog food kibbles.
- BSFL has a positive influence on the durability of dog food kibbles when processes at 130 °C.

THANK YOU!

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