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Insect's based extruded feed: process optimization and impact on *in vitro* digestibility



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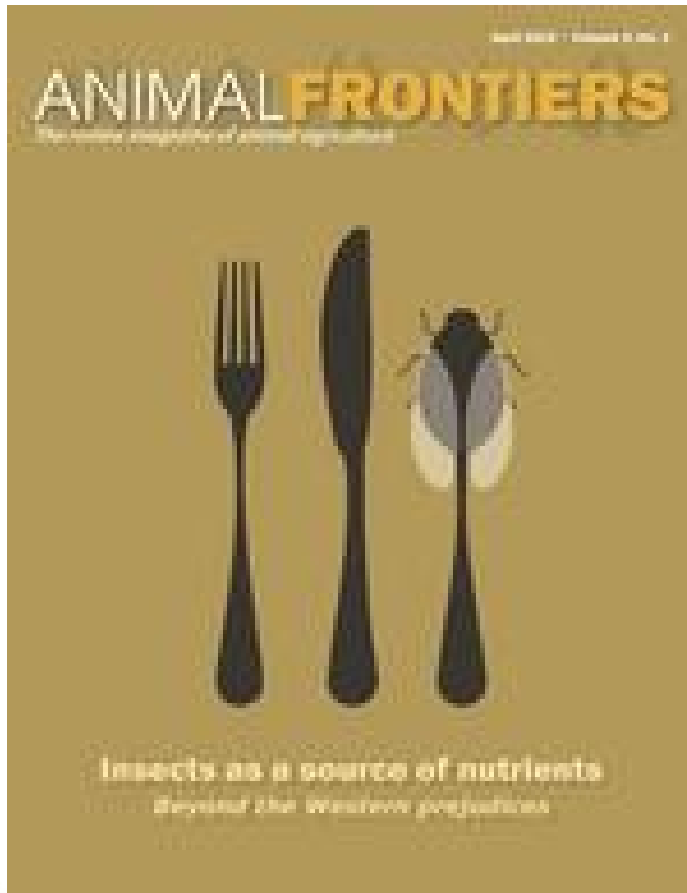


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FACOLTÀ DI MEDICINA VETERINARIA

Dipartimento di
Scienze veterinarie per la Salute
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Alternative protein source_INSECTS



From spare food to spare ribs

Researchers are studying how to use insects raised on waste to feed farm animals and fish.

Waste

Insects can feed on leftover food, grains discarded by distilleries, or even manure.

Flies

Adult flies are kept in a room; their eggs are collected.

Larvae

The eggs develop into larvae. Some of them are allowed to grow into flies to lay more eggs.

Pressing

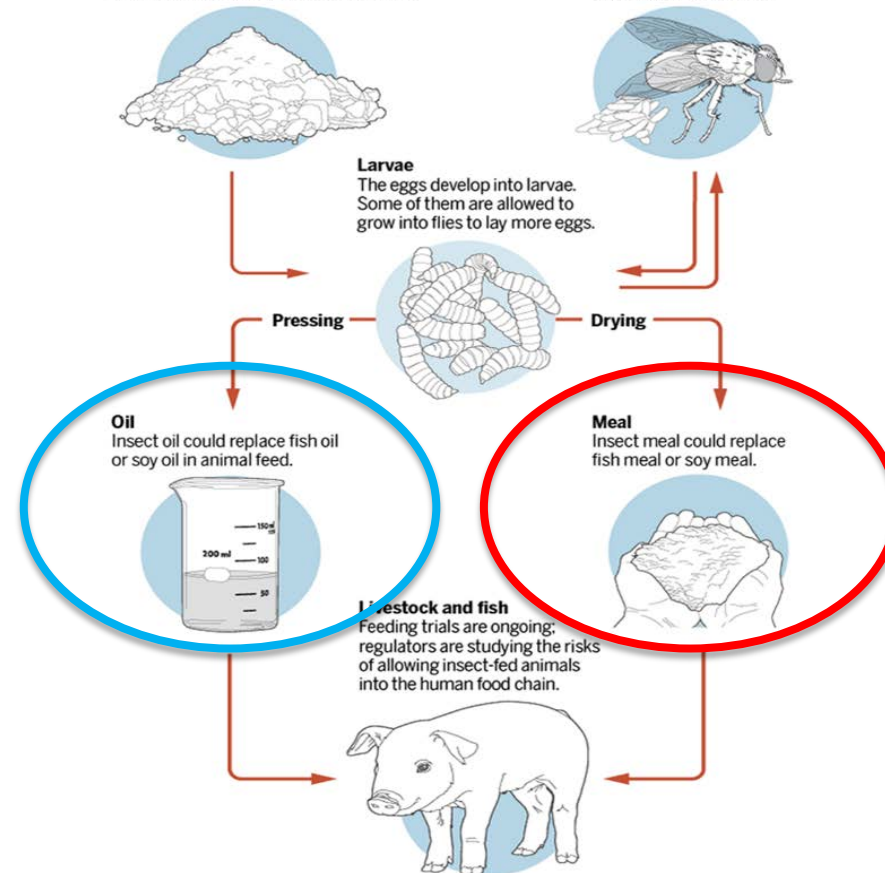
Drying

Oil
Insect oil could replace fish oil or soy oil in animal feed.

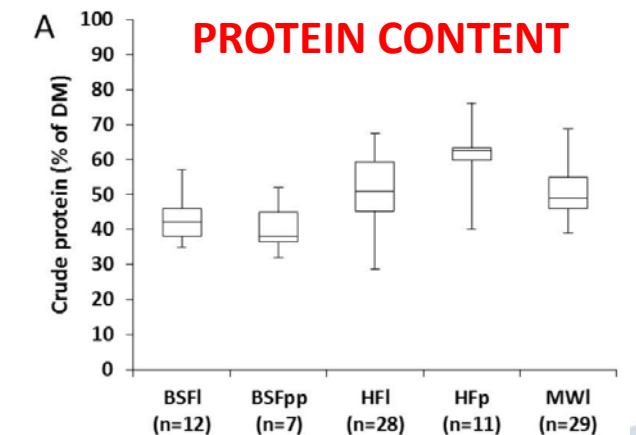
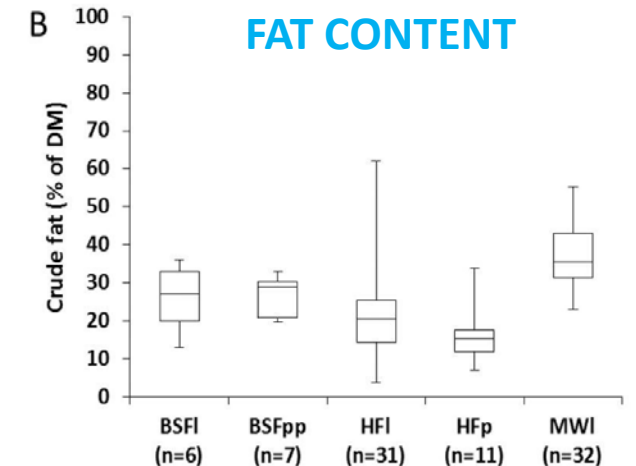
Meal
Insect meal could replace fish meal or soy meal.

Livestock and fish

Feeding trials are ongoing; regulators are studying the risks of allowing insect-fed animals into the human food chain.



Modified from Kupferschmidt, 2015



Modified from Veldkamp and Bosch, 2015



Insects as feed for animals

state of art

- **Black Soldier Fly (BSF)** is one of the most **promising species** in terms of nutritional value.
- **Lack of knowledge** about the characteristics of insects when included in feed.



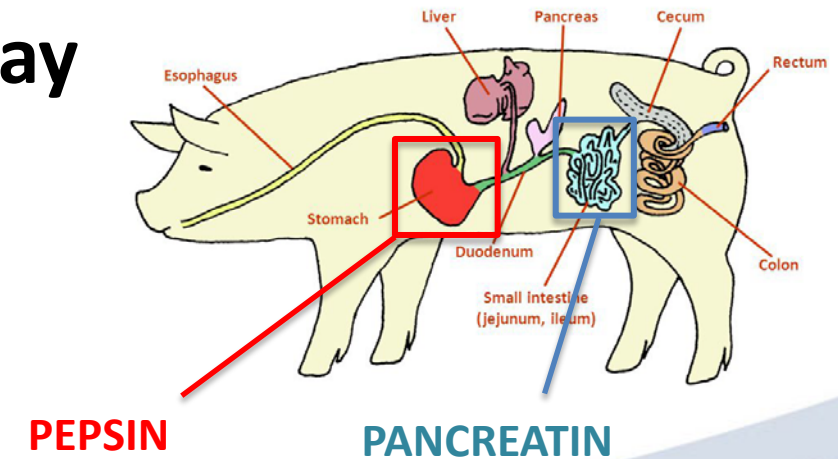
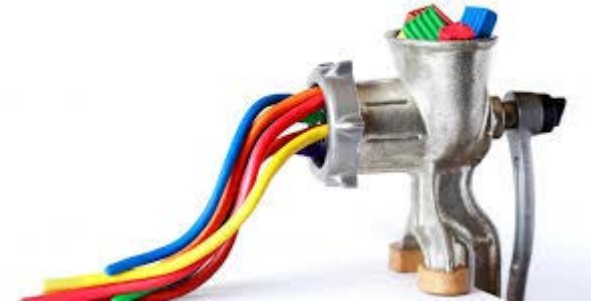
Aims

- to investigate the inclusion of black soldier fly (BSF) material in an **experimental extruded feed**
- and to evaluate the impact of extrusion on the nutritional value and **digestibility**.



Material and method

- Experiment 1 **_EXTRUSION**
 - Effect of nutrient on extrusion process
- Experiment 2 **_Extrusion + *in-vitro* dig. assay**
 - Effect of extrusion conditions on digestibility



Chemical composition BSF

Moisture %	DM %	Ash (% DM)	Protein (% DM)	Fat (% DM)
59-65	35-41	3-20	30-40	22-41

- High water content
- Differences due to the substrate used for growing insect and physiological stage (data not presented)











Material & method _Experiment 1

Co-rotating, conical twin-screw mini extruder (HAAKE™ MiniLab II)






Mixtures & extrusion conditions

- 5 mixtures: insect25 + wheat75 ± oil
- Barrel T° 60° C
- Screw speed 60 rpm

Premix BSF + wheat 25:75	Moisture %	Protein % af	Crude fat %af	Ash % af
Prepupae 	24.21	11.48	3.15	2.34
Prepupae low oil 	24.02	11.39	3.89	2.32
Prepupae medium oil  	23.84	11.30	4.63	2.30
Prepupae high oil   	23.65	11.21	5.37	2.29
Larvae 	23.71	10.93	4.62	1.67



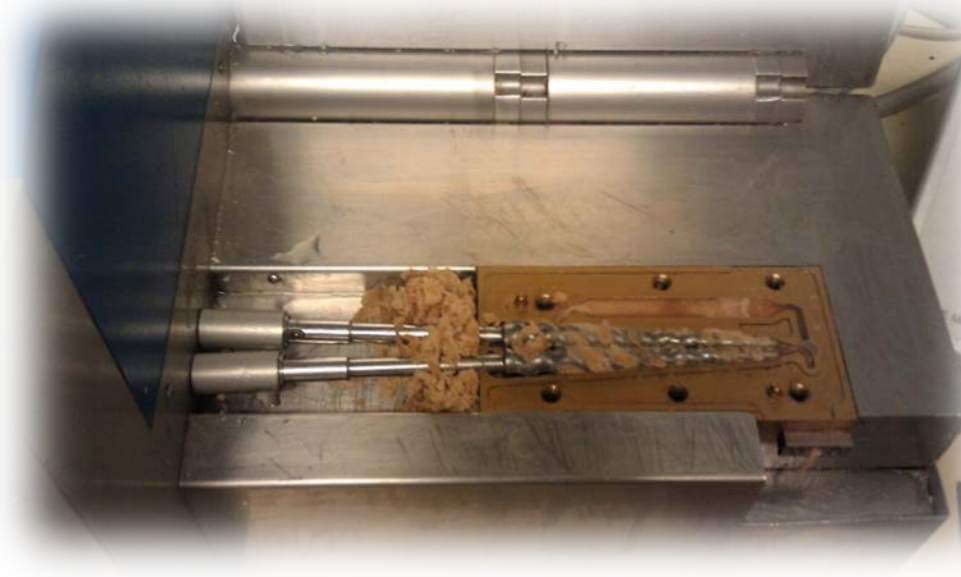
Results & discussion _Experiment 1

premix Insect+wheat 25:75	Crude fat %af	Torque value Ncm	Extrudability
Prepupae 	3.15	>400	Not extrudable
Prepupae low oil 	3.89	200-400	Not extrudable
Prepupae medium oil 	4.63	100-130	OK
Prepupae high oil 	5.37	50-100	Best value
Larvae 	4.62	80-120	OK

BEST MIXTURE
Larvae + wheat 25:75 NO OIL

Material & method _Experiment 2

- Single mixture larvae + wheat 25:75
- 4 extrusion temperature tested
 - 60 – 70 – 80 – 90° C
- Screw speed 100 rpm
- Water loss
- In-vitro digestibility



In-vitro test (Dierick, 1991)

Protein digestibility

Organic matter digestibility

1. Incubation with **pepsin**
2. Incubation with **pancreatin**
3. Centrifugation

4a. Determination **indigested CP**
(*kjeldahl*)




4b. Determination **indigested OM**
(=DM-ash)



Results & discussion _Experiment 2

Effect of extrusion on water loss



extr. T°	DM %	Water loss %
Control	75.21	-
60	80.23	6.67
70	79.68	5.94
80	79.50	5.70
90	78.94	4.96



Results & discussion _Experiment 2

In-vitro Protein digestibility

	P dig. %	
	Average	CV
CTR	93.54	0.63
60	94.49	0.91
70	94.54	0.31
80	94.21	0.15
90	94.02	0.63



Results & discussion _Experiment 2

In-vitro OM digestibility

	OM dig	
	Mean	CV
CTR	81.37	2.86
60	95.69	1.66
70	94.18	0.30
80	95.38	1.26
90	95.01	0.39



Summary

- Extrusion
 - Best mixture LARVAE+WHEAT 25:75 NO OIL
 - Fat content in the mixture is a key variable
 - Water loss???
- Digestibility
 - Extrusion can contribute to **increasing OM digestibility** in insect containing feed blends
 - Extrusion do **not affect CP digestibility** in insect containing feed blends
- Remarks: very simple mixture, small scale system,....



Thanks for the attention



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