Insects in animal feed:
beyond the protein concept

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Black Soldier Fly larvae feed the future of laying hens: benefits for welfare and circularity

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Introduction 1

Growing interest for insects in poultry production

mealworm
(MW, *Tenebrio molitor*)

Insects as nutritional feed ingredient

- ✓ Alternative protein source;
- ✓ Satisfactory sources of nutrients (proteins, fat, energy, vitamins, minerals, antimicrobial peptides);
- ✓ Contain substances that work as antimicrobial agents

Black Soldier Fly larvae
(BSF, *Hermetia illucens*)

Introduction 2

Growing interest for insects in poultry production

Insects as sustainable solution

- ✓Replacement of soy;
- ✓Low environmental impact;
- ✓Making the food chain more circular

Image: World Financial Review

Introduction 2

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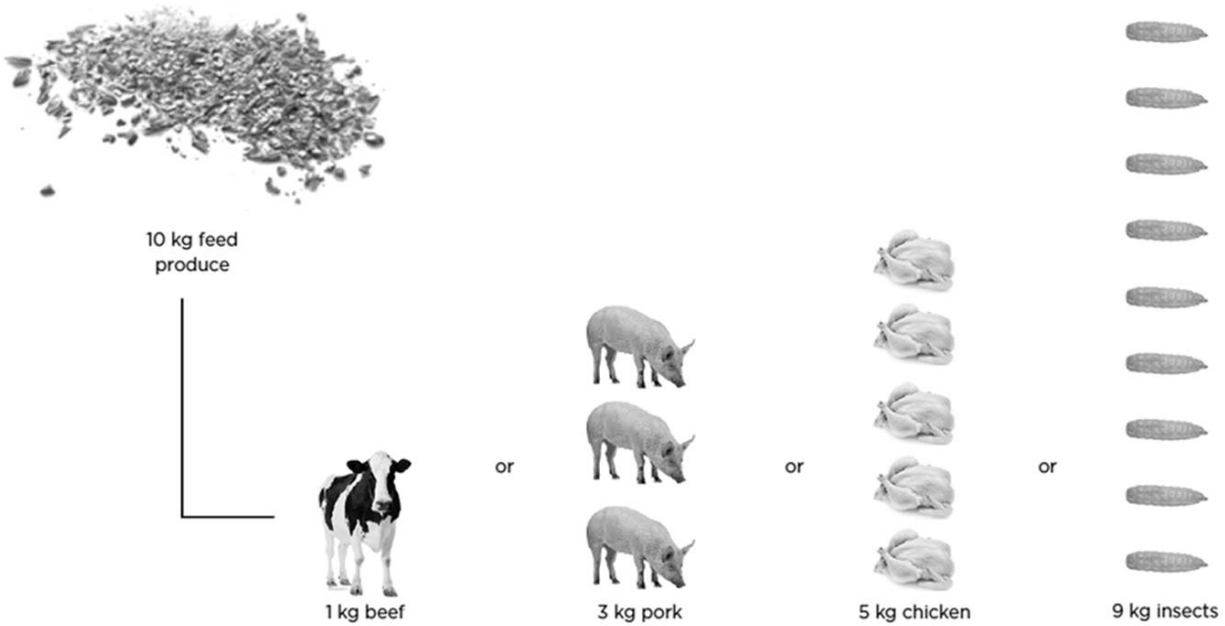

Feed efficiency

Image: World Financial Review

Source: www.livinstudio.com/farm432/

Introduction 3

Growing interest for insects in poultry production

Insects as sustainable solution

- ✓ Utilization of low-grade bio-waste products, manure – *BUT both residual flows (animal origin, with some exceptions, eggs, milk, ..) and manure are currently not permitted as rearing substrates for insects; for safety reasons*

Image: World Financial Review

Introduction 4

Growing interest for insects in poultry production

Insects to enrich the life of poultry

- ✓ Improving welfare as enrichment that encourages foraging behaviour;
- ✓ Preventing feather pecking and cannibalism

Black Soldier Fly larvae feed the future of laying hens – Marko Ruis

Introduction 5

Insect meals for poultry - restrictions

- ✓ Feeding of insect protein/insect meals to farm animals is currently not allowed in the European Union;
- ✓ *It is allowed for farmed fish and pet food (approval to use insect protein in aquafeed in 2017);*
- ✓ Live insects and insect oil are allowed to be fed to farm animals

Research objective

To measure the effects of feeding live Black Soldier Fly (BSF) larvae (*Hermetia illucens*) on welfare and production of laying hens


Wadudu Insect Centre


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wadudu insect center

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Experiments

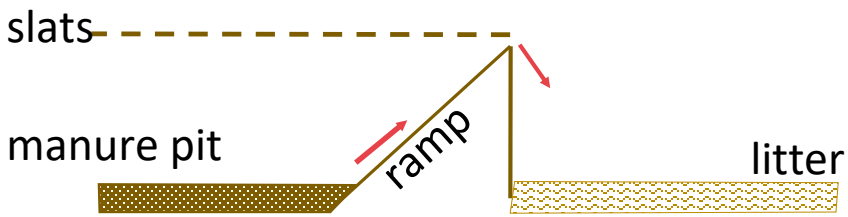
Two experiments, each with 400 Bovans Brown laying hens

20 units having 20 hens (n=5-7/treatment)

BSF larvae were fed **alive** to these hens from 20-36 wks of age, additionally to unlimited mash feeding

Experimental facility

Experimental set-up - Treatments



4-5 days old larvae in manure under slats twice per week, development to adult in manure; 70 g young larvae placed in manure each time

In both experiments, a **'self-harvesting system'**, in which BSF larvae are reared on poultry manure in the hen house, was one of the feeding treatments

Experimental set-up - Treatments

Experiment 1: 4 treatments

1. Only mash feed, no insects provided (control);
2. BSF larvae provided daily in the feed bin (1% of ration daily);
3. BSF larvae spread daily in the litter (1% of ration daily);
4. BSF larvae crawling from slats (‘*self-harvesting*’)

Experimental set-up – Variables both experiments

Measurements

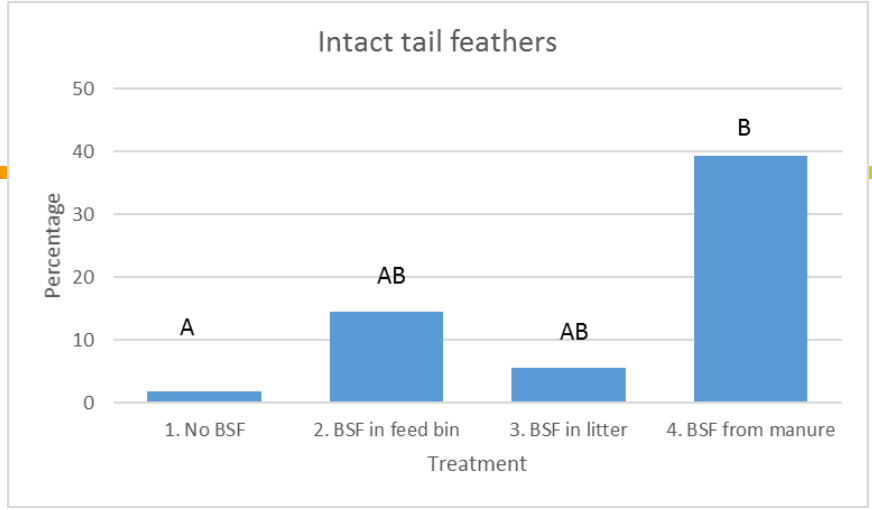
- Behavioural observations with 1-min scan sampling
  - Pecking behaviours
  - Active (scratching, eating, drinking, preening, dustbathing, walking)
  - Inactive (resting, nesting)
- Plumage and skin condition
- Production performance, BW and uniformity

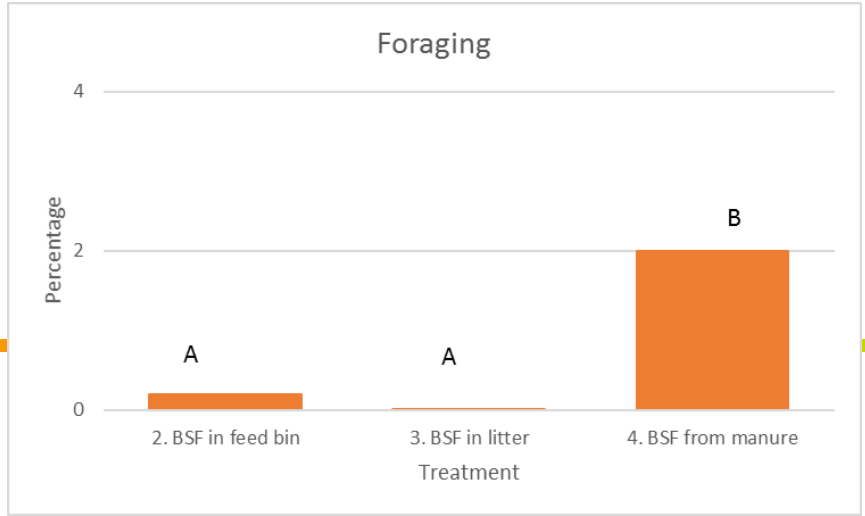
For repeated measures, mixed models were used, with treatment, period and interactions as predictors (laying period divided in four periods). For single measures one-way ANOVA was used

Results – behaviour/plumage

- Although not picked up by direct observations, feather pecking damage was decreased in T4 hens: they maintained the highest quality of tail feathers

- Activity highest in T4 hens, with prolonged foraging activity





Experiment 1

Results – production performance

	Treatment			
	1. No BSF	**2. BSF in feed bin**	**3. BSF in litter**	**4. BSF - manure**
Hen weight (kg) (36 wks)	1,84	1,84	1,83	1,84
Egg weight* (g)	59,2	58,8	59,8	59,7
Feed intake* (g/hen/day)	127	128	127	126
Feed efficiency (kg feed/kg egg)**	2,63 ^{A}	2,39 ^{AB}	2,56 ^{A}	**2,23 ^{B}**
Laying rate* (hen-day egg production)	84 ^{A}	92 ^{B}	91 ^{B}	**94 ^{B}**
Uniformity* (36 wks)**	81	86	83	79

T4 hens had:

- Highest feed efficiency
- Highest laying rate, together with T2 and T3 hens

Experiment 1

*Whole period **Last 4 weeks *** % hens within 10% of average weight

Experimental set-up - Treatments

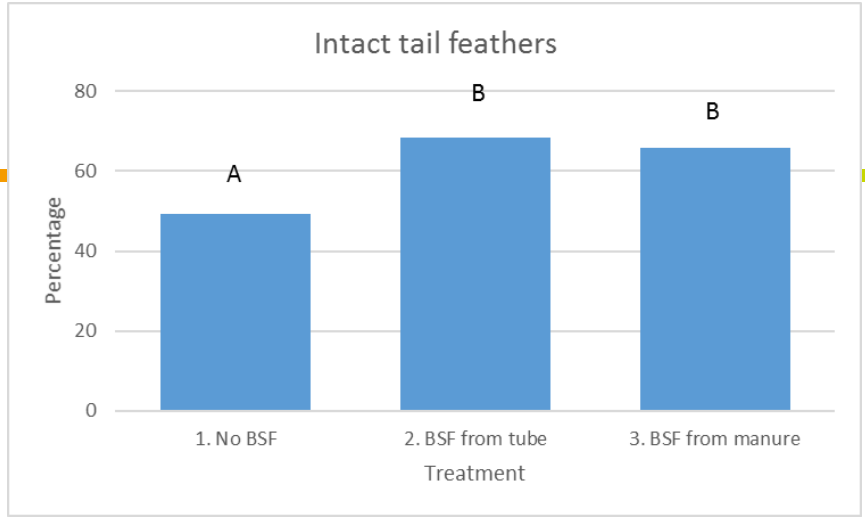
Promising results T4, but legislative restrictions!

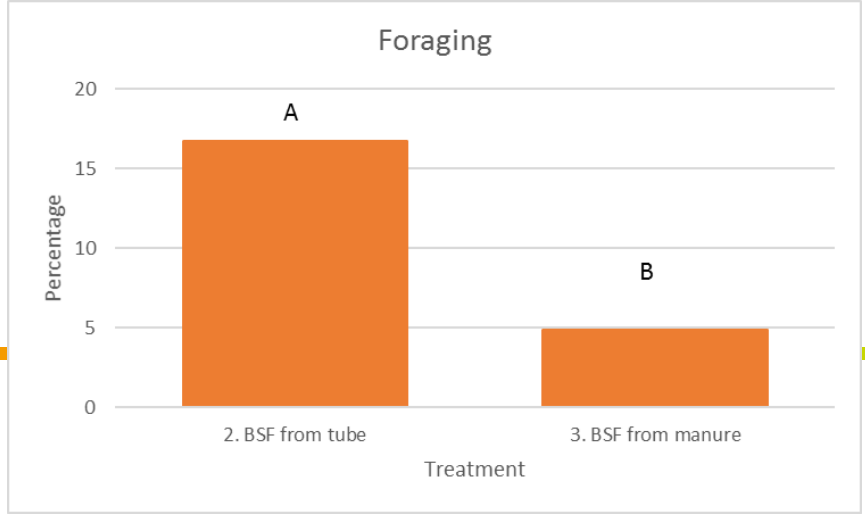
Experiment 2: 3 treatments

1. Only mash feed, no insects provided (control);
2. BSF provided in perforated tube in litter (5-10% of ration daily);
3. BSF larvae crawling from slats (‘*self-harvesting*’)

Results – behaviour/plumage

- Feather pecking damage was decreased in T2 and T3 hens: they maintained the highest quality of tail feathers;
- General activity higher in T2 and T3 hens; most obvious in T3 hens;
- Foraging activity T2 hens much higher than in T3 hens.





Experiment 2

Results – production performance

	Treatment		
	1. No BSF	**2. BSF from tube**	**3. BSF from manure**
Hen weight (kg) (36 wks)	1,93 ^{A}	1,94 ^{A}	**1,90 ^{B}**
Egg weight* (g)	61,1 ^{AB}	61,4 ^{B}	**60,4 ^{A}**
Feed intake* (g/hen/day)	129 ^{A}	**124 ^{B}**	126 ^{AB}
Feed efficiency (kg feed/kg egg)**	2,36	2,31	2,34
Laying rate (hen-day egg production)**	92	90	90
Uniformity* (36 wks)**	86	85	84

T3 hens had lowest egg and body weights

In T2 hens production performance was ensured, despite the increased behavioural activity

Lower feed intake T3; compensated by insect consumption?

Experiment 2

*Last 4 weeks **Whole period *** % hens within 10% of average weight

Discussion and conclusion 1

- Insect consumption in self-harvesting system unknown;
- Uptake of larvae with perforated tube more controlled;
- Both may have a positive effect on behaviour and production:
  - They enrich the life of laying hens with prolonged time of foraging (increased welfare)
  - Nutritional effect (perforated tube)
  - *Perforated tubes combine both!*

Discussion and conclusion 2

- From a sustainability perspective, rearing BSF on manure is promising;
- Its implementation depends on adaptation of legislation;
- Young BSF larvae grew well on the manure, and reduced the amount of manure by 20%;
- For stress-reducing AND nutritional effect, BSF may be harvested from manure and fed through perforated tubes;

Image: World Financial Review

Thank you for your attention!

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