

Novel Feed Ingredients for Young Pigs



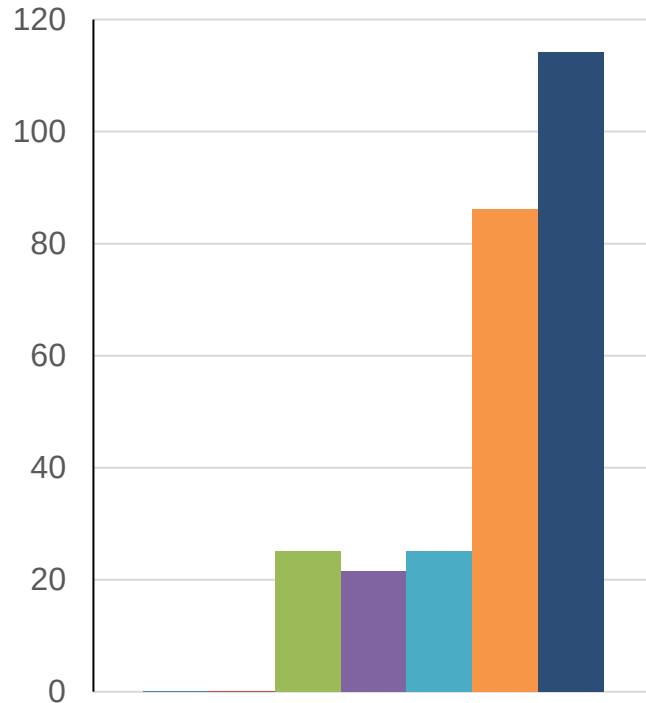
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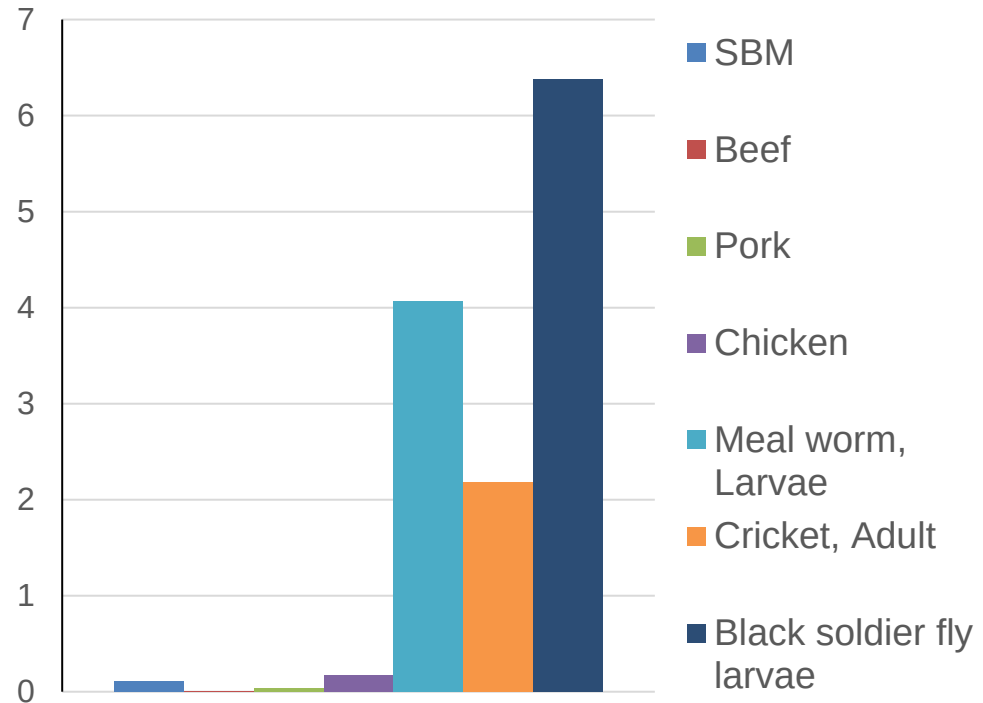


Insect based feed ingredients

Protein yield,
kg/m² per year



Protein yield with feedstock inputs,
kg/m² per year

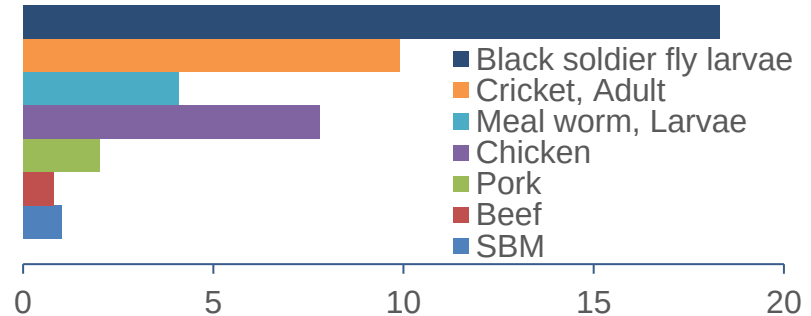


Black Soldier Fly Larvae



✓ Commercially produced black soldier fly larvae contain approximately 35-50% protein and 20-25% oil (on a dry matter basis)

Growth cycles per year



Black Soldier Fly Larvae (BSFL) Products

Defatted BSFL Meal



Nutrient	%
Dry matter	95.45
Protein	42.63
Fat	13.20
Calcium	2.88
Phosphorus	1.00
Lysine	1.92
Methionine	0.53
Threonine	1.20
Tryptophan	0.50
Valine	2.49

BSFL Oil



Total lipids	99.15
Lauric (C12:0)	36.9
Myristic (C14:0)	9.84
Palmitic (C16:0)	14.6
Palmitoleic (C16:1)	1.87
Stearic (C18:0)	2.15
Oleic (C18:1)	13.05
Linoleic (C18:2)	17.25
α -Linolenic (C18:3)	1.49

BSFL Frass

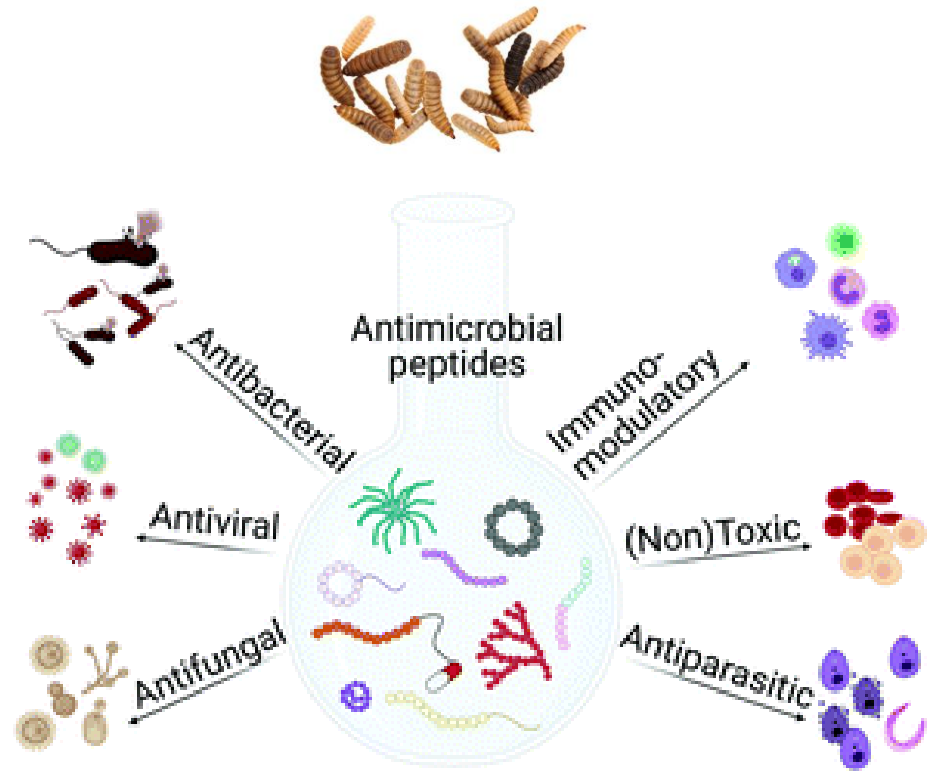


Nutrient	%
Dry matter	95.45
Protein	30.56
Fat	8.03
Ash	8.29
NDF	32.34
ADF	15.60
Calcium	1.26
Phosphorus	0.96

Analyzed composition of products used in our studies. Quality and nutritional composition of BSFL based ingredients varies due to differences in feedstock and processing methods

Black Soldier Fly Larvae (BSFL) Products

- Upcycling of low quality feed ingredients
 - ✓ Have to be fed AAFCO defined ingredients
- Sustainable source of nutrition
 - ✓ Protein Meal
 - ✓ Oil (lauric acid)
 - ✓ Frass
- Functional properties
 - ✓ Antimicrobial peptides
 - Non-specific defense against pathogens
 - Insects have antimicrobial
 - ✓ Chitin

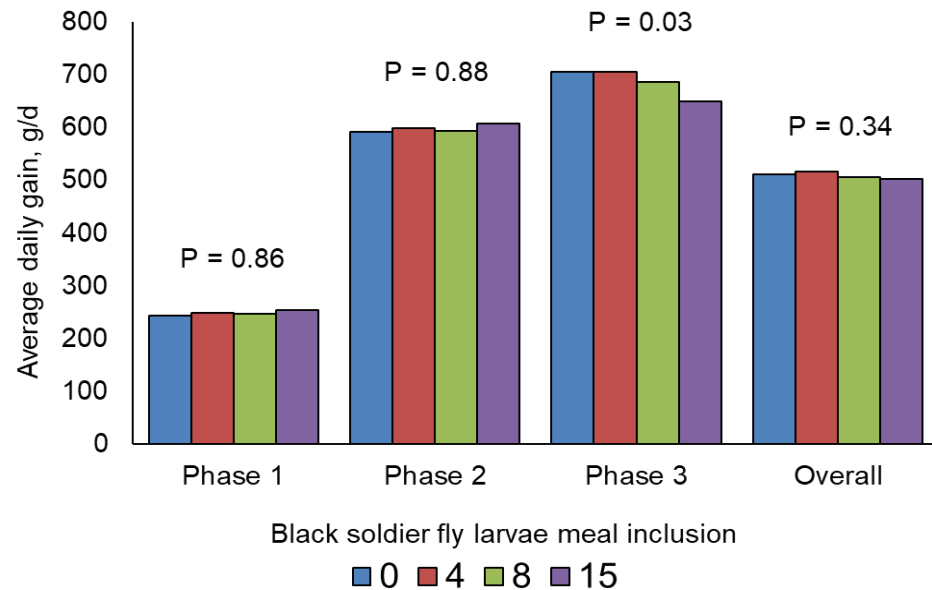
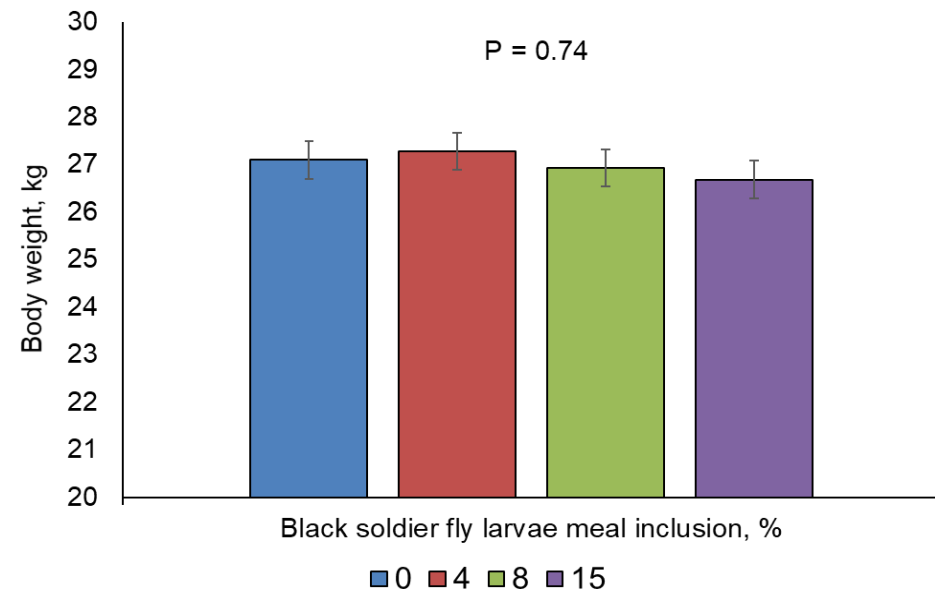


Impact of black soldier fly larvae meal in nursery pigs

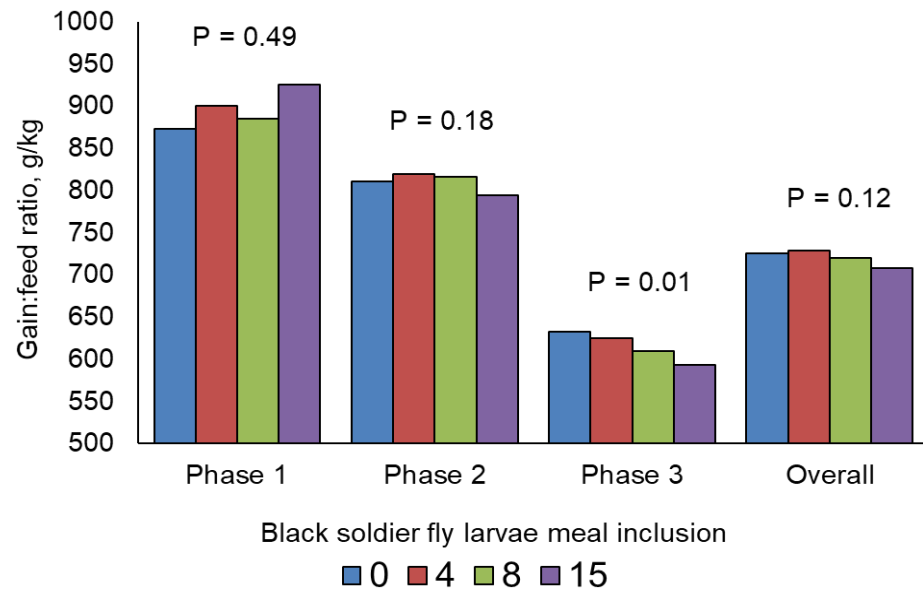
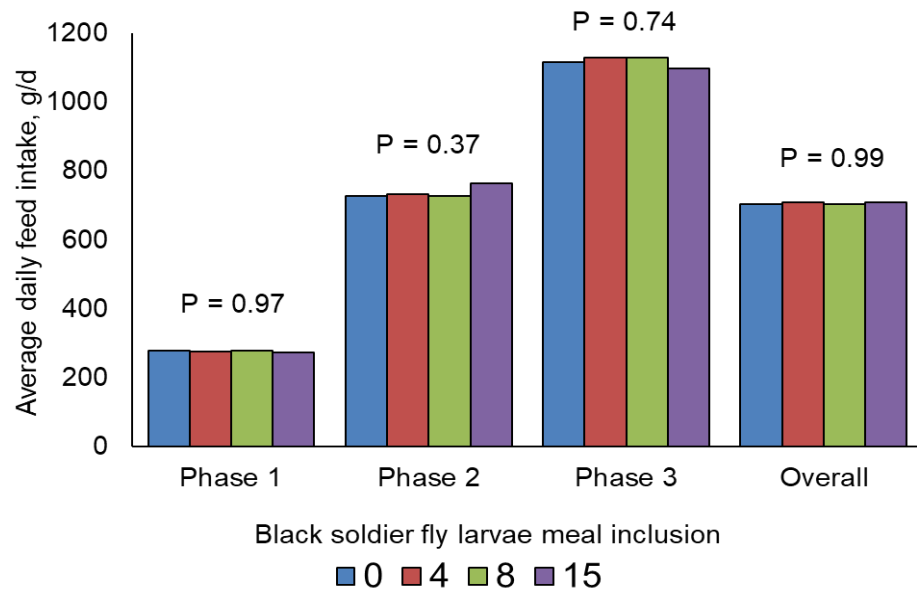
Defatted BSFL Meal - Swine Education Unit, Raleigh

- 192 nursery pigs (4.76 to 7.48 kg of body weight)
- 4 pigs per pen using a total of 48 pens; 12 replicates per treatment
- 4 dietary treatments:
 - ✓ Diet 1 - Control diet with a high quality protein source (low-ash poultry byproduct meal)
 - ✓ Diet 2 - Control diet with **4% defatted BSFL meal** replacing poultry byproduct meal and soybean meal
 - ✓ Diet 3 - Control diet with **8% defatted BSFL meal** replacing poultry byproduct meal and soybean meal
 - ✓ Diet 4 - Control diet with **15% defatted BSFL meal** replacing poultry byproduct meal and soybean meal
- 3 dietary phases of 14, 13, and 14 days, respectively

Impact of black soldier fly larvae meal in nursery pigs



Impact of black soldier fly larvae meal in nursery pigs

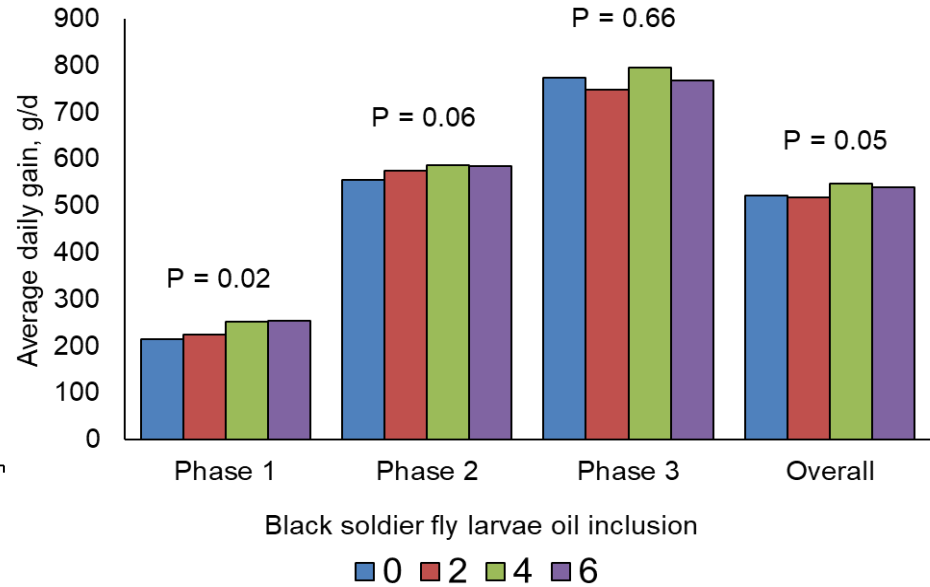
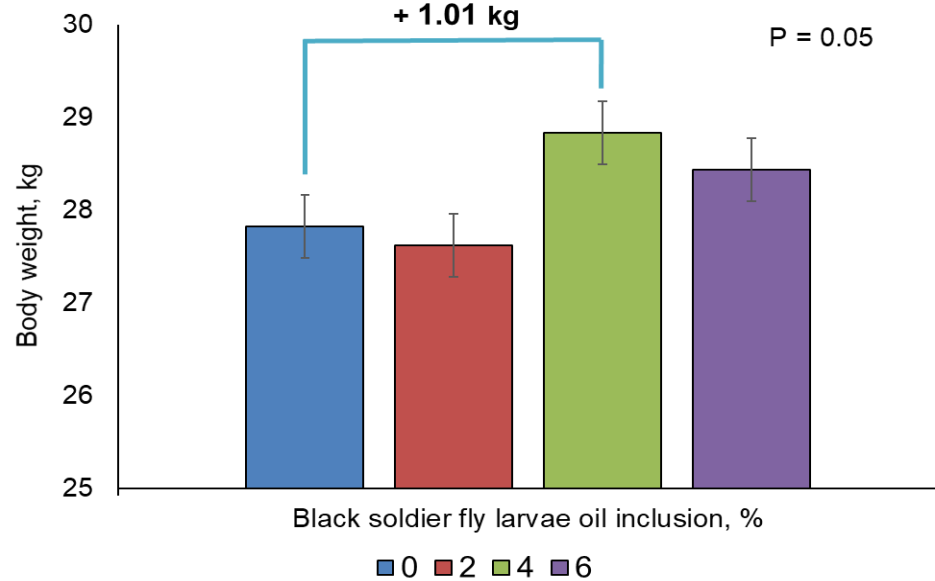


Impact of black soldier fly larvae oil in nursery pigs

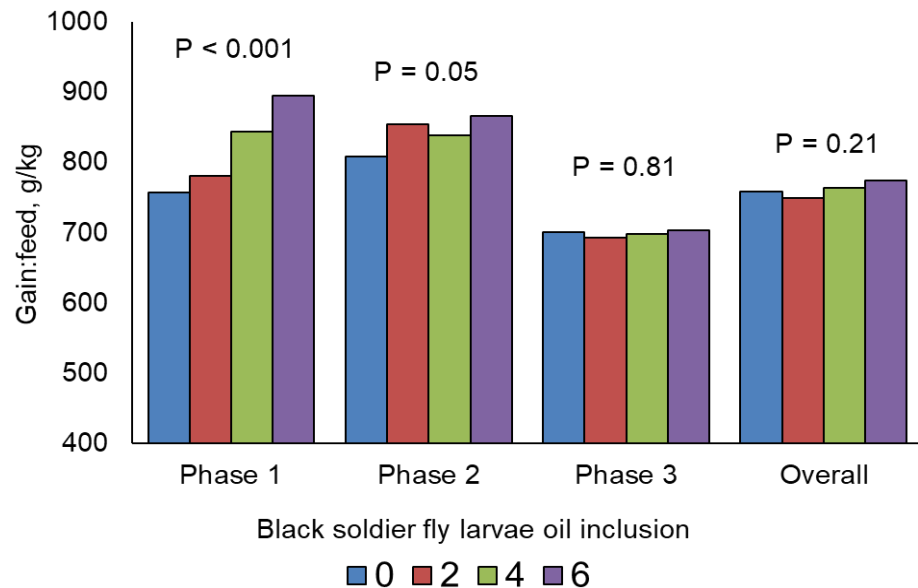
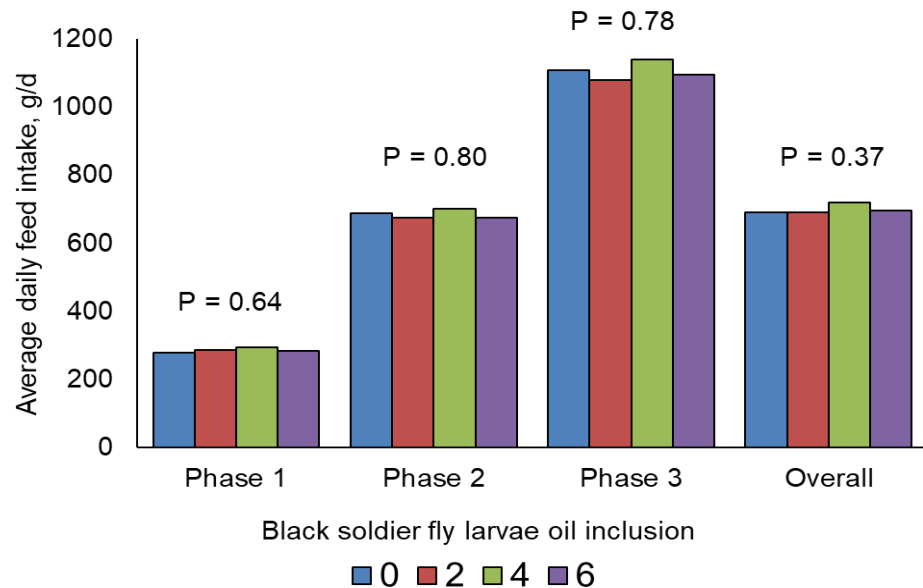
BSFL Oil - Swine Education Unit, Raleigh, NC

- 192 nursery pigs (4.71 to 9.28 kg of body weight)
- 48 pens total, 4 pigs/pen, 12 replicates/treatment
- 4 dietary treatments:
 - ✓ Control diet with 6% corn oil
 - ✓ 2% BSFL oil replacing corn oil
 - ✓ 4% BSFL oil replacing corn oil
 - ✓ 6% BSFL oil replacing all corn oil
- BSFL oil replaced corn oil 1:1
- 3 dietary phases of 14, 13, and 14 days, respectively

Impact of black soldier fly larvae oil in nursery pigs

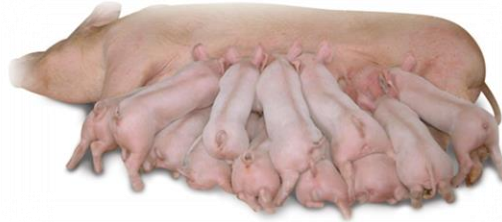


Impact of black soldier fly larvae oil in nursery pigs



Impact of black soldier fly larvae oil in nursery pigs

BSFL Oil - Tidewater Research Station, Plymouth, NC



Gestation

Lactation

Nursery

- ✓ Start on day 80 of gestation
- ✓ Feed 4.5 lbs per day
- ✓ Measure body weight and condition score

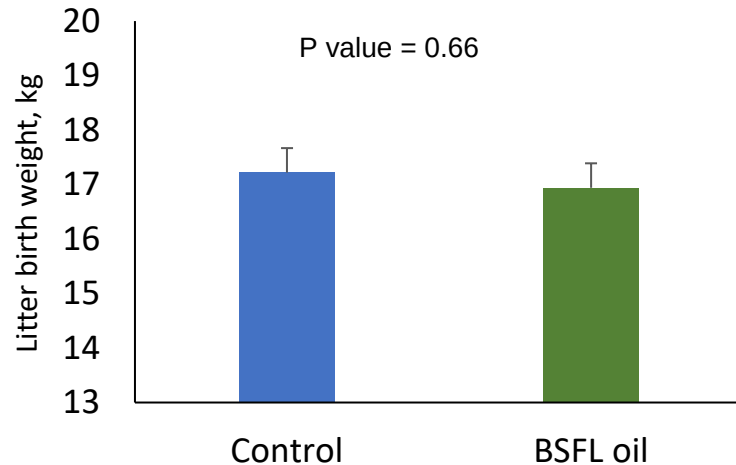
- ✓ Litter performance
- ✓ Colostrum and milk samples
- ✓ Blood samples
- ✓ Fatty acid analysis

- ✓ Nursery growth and feed efficiency
- ✓ Blood samples
- ✓ Serum chemistry panel and fatty acid analysis

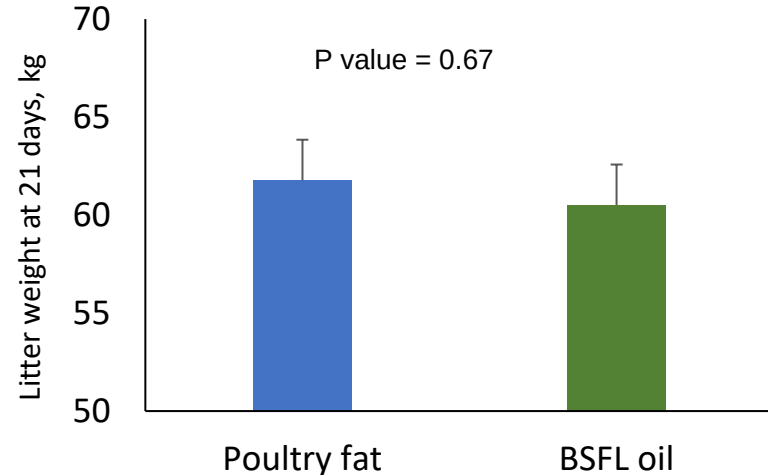
Impact of black soldier fly larvae oil in sows

Data are for a total of 72 sows; Analyzed using litter size at birth as covariate

Gestation



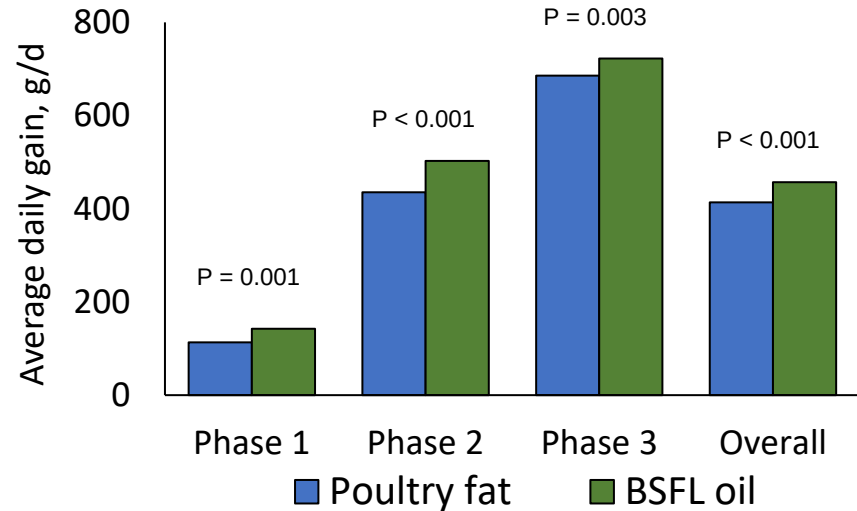
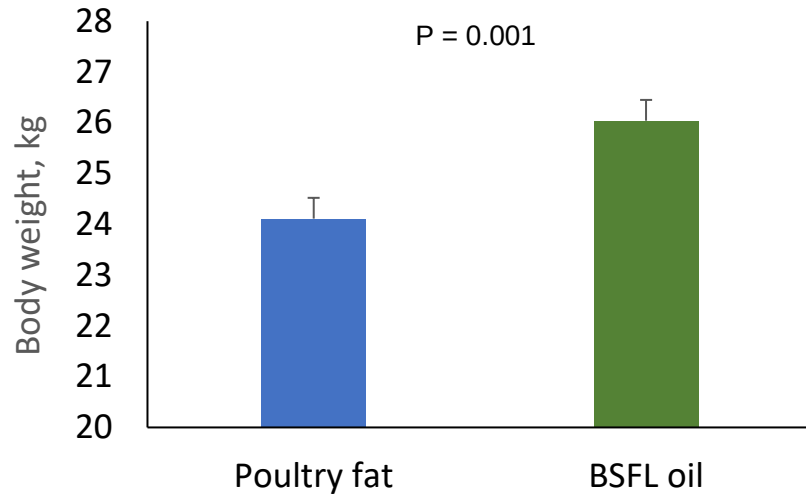
Lactation



Performance of sows fed black soldier fly larvae oil was not impacted compared to sows fed control in gestation or poultry fat in lactation

Impact of black soldier fly larvae oil in nursery pigs

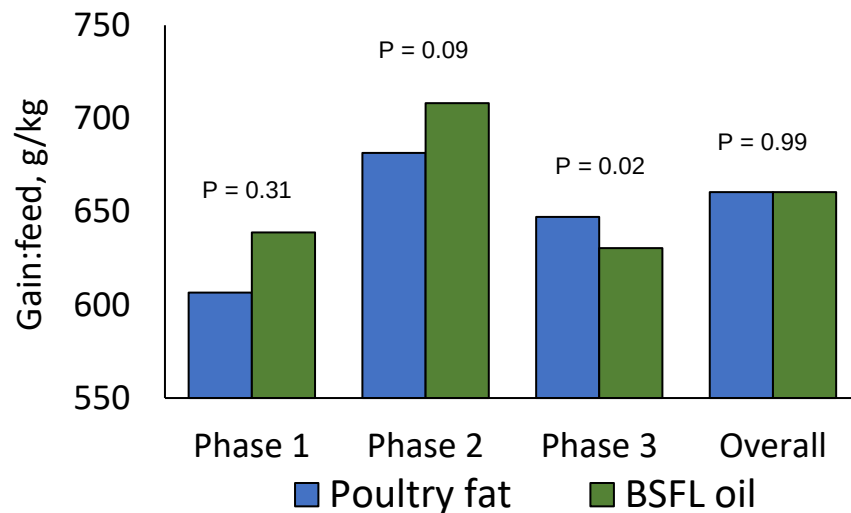
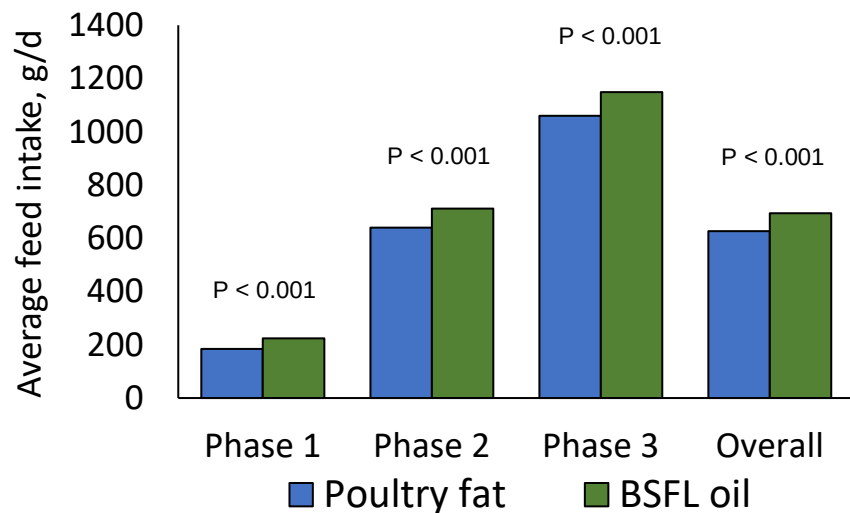
Represents 48 pens; 6 to 7 pigs per pen; total of 306 pigs; Starting body weight of 6.68 kg



Pigs fed black soldier fly larvae oil were 1.93 kg (4.25 lbs) heavier than pigs fed poultry fat

Impact of black soldier fly larvae oil in nursery pigs

Represents 48 pens; 6 to 7 pigs per pen; total of 306 pigs; Starting body weight of 6.68 kg



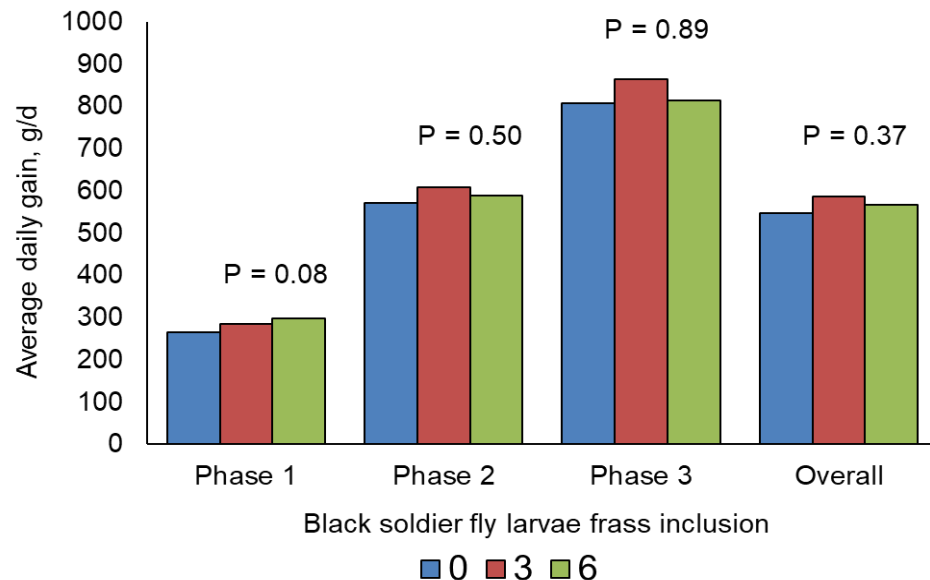
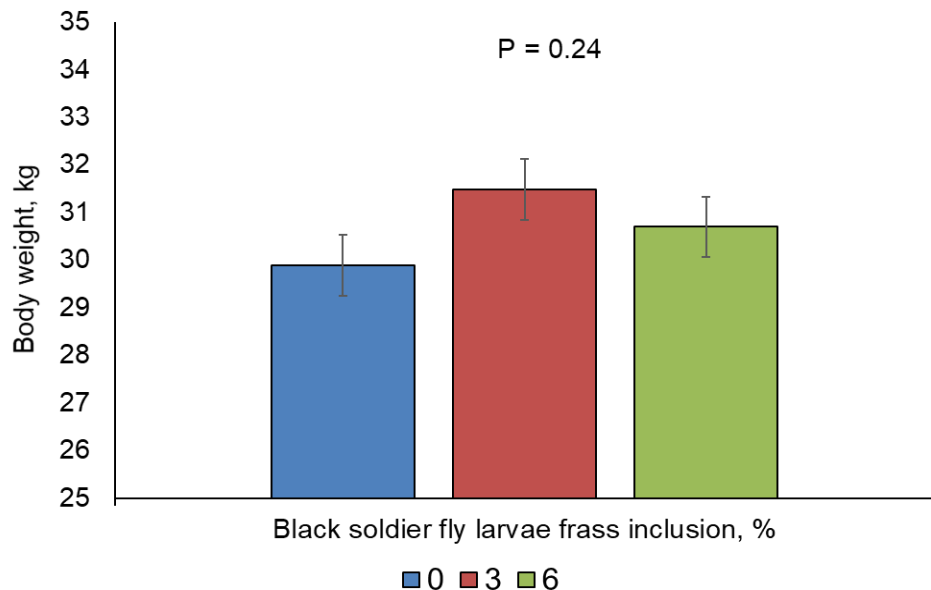
Impact of black soldier fly larvae frass in nursery pigs

BSFL Frass - Swine Education Unit, Raleigh

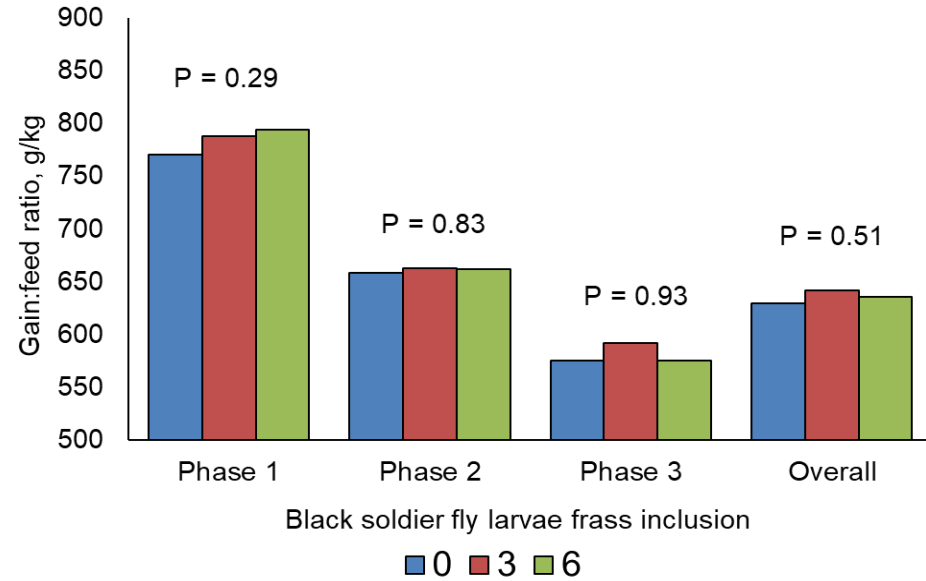
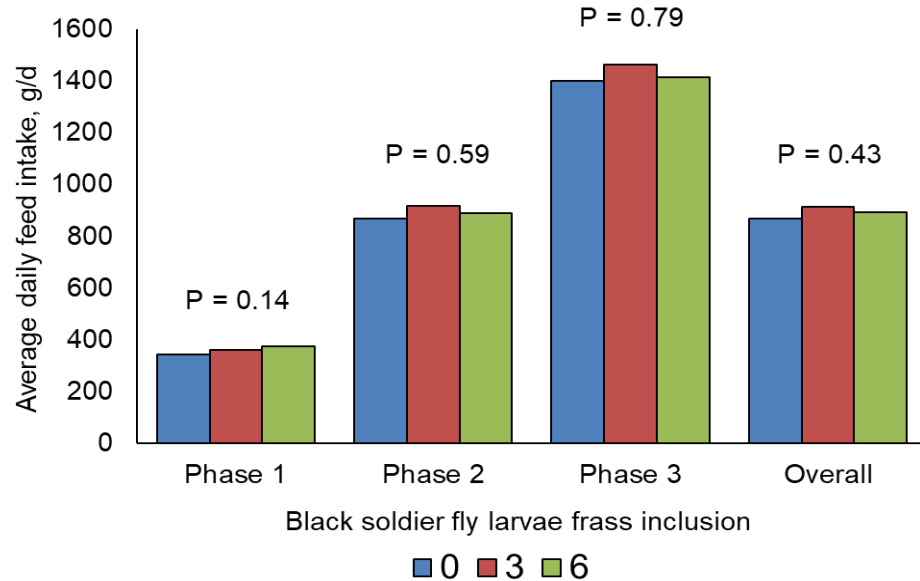
- 120 nursery pigs (6.85 kg average body weight)
- 4 pigs per pen using a total of 30 pens; 10 replicates per treatment
- 3 dietary treatments:
 - ✓ Control diet
 - ✓ Control diet with 3% **BSFL frass**
 - ✓ Control diet with 6% **BSFL frass**
- 3 dietary phases of 14 days each

Frass is the leftover material from the exoskeleton shedding, leftover dietary substrate, larvae waste, and excrement of the black soldier fly larvae

Impact of black soldier fly larvae frass in nursery pigs



Impact of black soldier fly larvae frass in nursery pigs



Conclusions and implications

➤ **Defatted black soldier fly larvae meal**

- ✓ Represents a high protein, digestible and palatable ingredient
- ✓ Competitive growth performance when formulated based on standardized ileal digestible amino acids

➤ **Black soldier fly larvae oil**

- ✓ Showed improved growth performance in 2 separate studies conducted in 2 different locations

➤ **Black soldier fly larvae frass**

- ✓ May improve growth performance of nursery pigs during the early stages of the nursery period
- ✓ No other studies have been reported in swine

➤ **Additional studies are needed**

- ✓ Evaluation of products during disease and stress
- ✓ Commercial level studies and field studies