

# Enrichment of the diet with insect-based feed ingredients for 1-Star Better Life labelled broilers; A Public-Private Partnership

Key findings;

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# Content

- PPP aim and content
- Animal experiment 1
- Large-scale study 2
- Animal experiment 3
- Conclusion



# Consortium

- VENIK (Verenigde Nederlandse Insectenkwekers)
- Protix B.V.
- ForFarmers Nederland B.V.
- ESBRO B.V.

2022-2024

# PPP aim

- Decrease the use of imported soy products by replacing them with Black Soldier fly larvae protein and oil in combination with regionally grown alternative protein sources
- The project aims to add elements in 1-star Better Life labelled broiler production by inclusion of sustainable insect-based feed ingredients. Sub-objectives (target list) are:
  - Promote sustainable feed ingredients in poultry feed
  - Substantiate animal health claims
  - Showing innovation power of partners involved (incl. **Communications “First mover positioning”**)
  - Poultry as insectivores – **back to nature**
  - Address challenges of retailers (**sustainability management**)
  - Examine effects on meat quality and organoleptic properties
  - Poultry diet conceptualization in a hypothetical mass-scale scenario (incl. **LCA**)



# PPP content

- Pilot 1:

Conceptualisation and investigation of including different BSF products (meal, meal with extra chitin, Fat) in the diet of slow-growing broilers

- Large scale:

Implementation of BSF products in diets of commercial 1-Star Better Life farms

- Pilot 2:

Conceptualisation and investigation of complete soybean meal and oil replacement by BSF products and other local ingredients in the diet of slow-growing broilers

# Deliverables

- Conferences:

Four oral presentations in EAAP 2023 and EAAP 2024

- Public article:

Large scale results

Pilot 1-LCA report

- Scientific article

# Pilot 1

- Aim:

to study the effects of low dietary inclusion levels of three insect products, i.e. **BSF meal**, **BSF meal with extra chitin**, and **BSF oil**, on broiler **health** and **welfare**, **performance**, **carcass characteristics**, and **sustainability**



# Study Design

- Breed: Hubbard JA757
- Trial facility: WBVR, Lelystad
- Experimental period: 0-56 days
- 8 treatments X 8 replicates
- Experimental unit: Pen
- Number of broilers: 22/pen (1408 day-old chickens)

Treatment	Description
<b>CTRL</b>	Control
<b>PKFA</b>	Same C12 content as BSFO2.5
<b>BSFO1%</b>	1% BSF oil
<b>BSFO2.5%</b>	2.5% BSF oil
<b>BSFM1%</b>	1% BSF meal
<b>BSFM5%</b>	5% BSF meal
<b>BSFMc1%</b>	1% BSF meal with extra chitin
<b>BSFMc5%</b>	5% BSf meal with extra chitin

# Diets

- Control diets contained soybean meal (20-26%) and soybean oil (2.5-3.8%)
- How much of SBM and SBO were replaced?

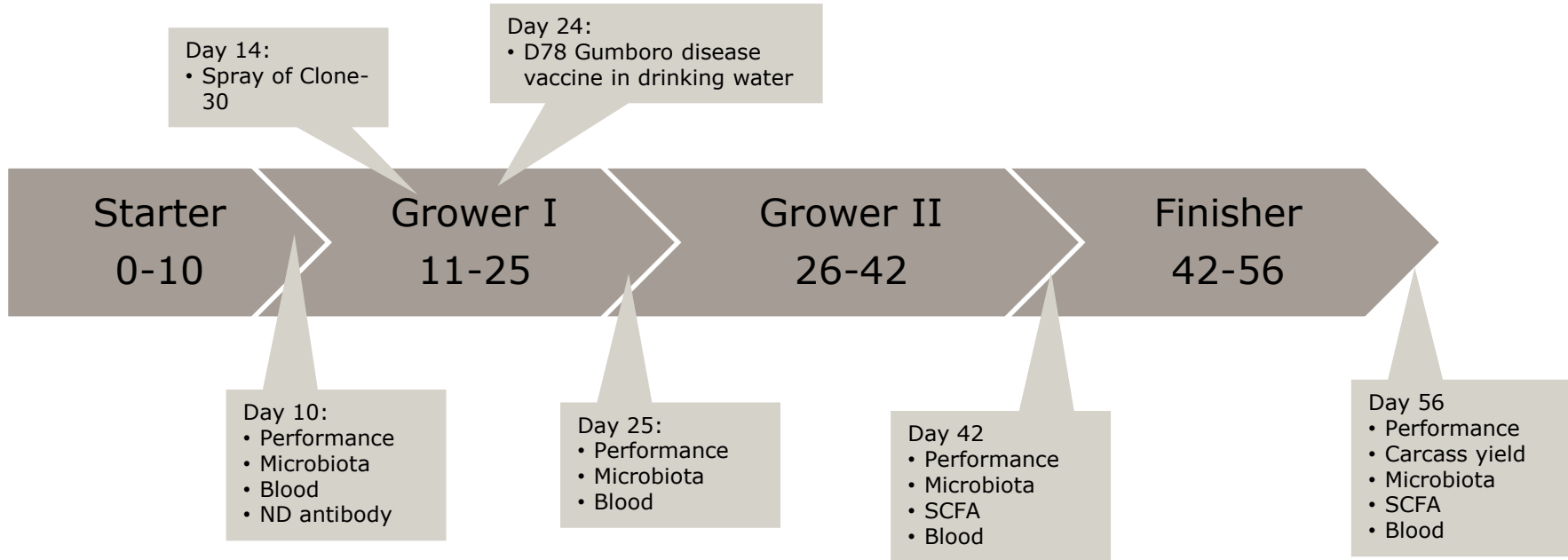
# Diets

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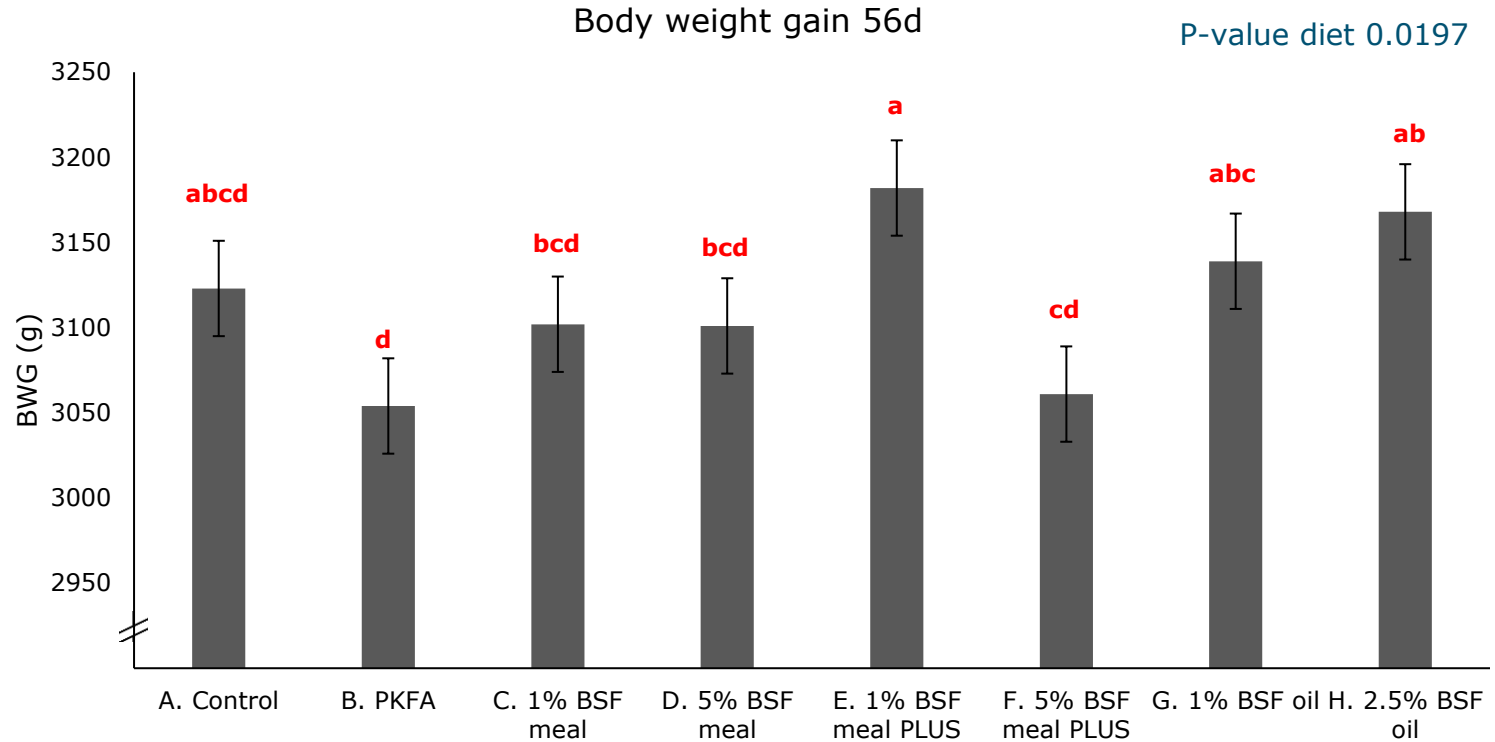
## Substitution (%) of SBM and SBO in relation to the control diet in different dietary program

	SBM	SBO
<b>PKFA</b>	0	90-60
<b>BSFO1%</b>	0	40-26
<b>BSFO2.5%</b>	0	100-66
<b>BSFM1%</b>	5	7-3
<b>BSFM5%</b>	25-30	28-20
<b>BSFMc1%</b>	5	6-3
<b>BSFMc5%</b>	25-30	20-28

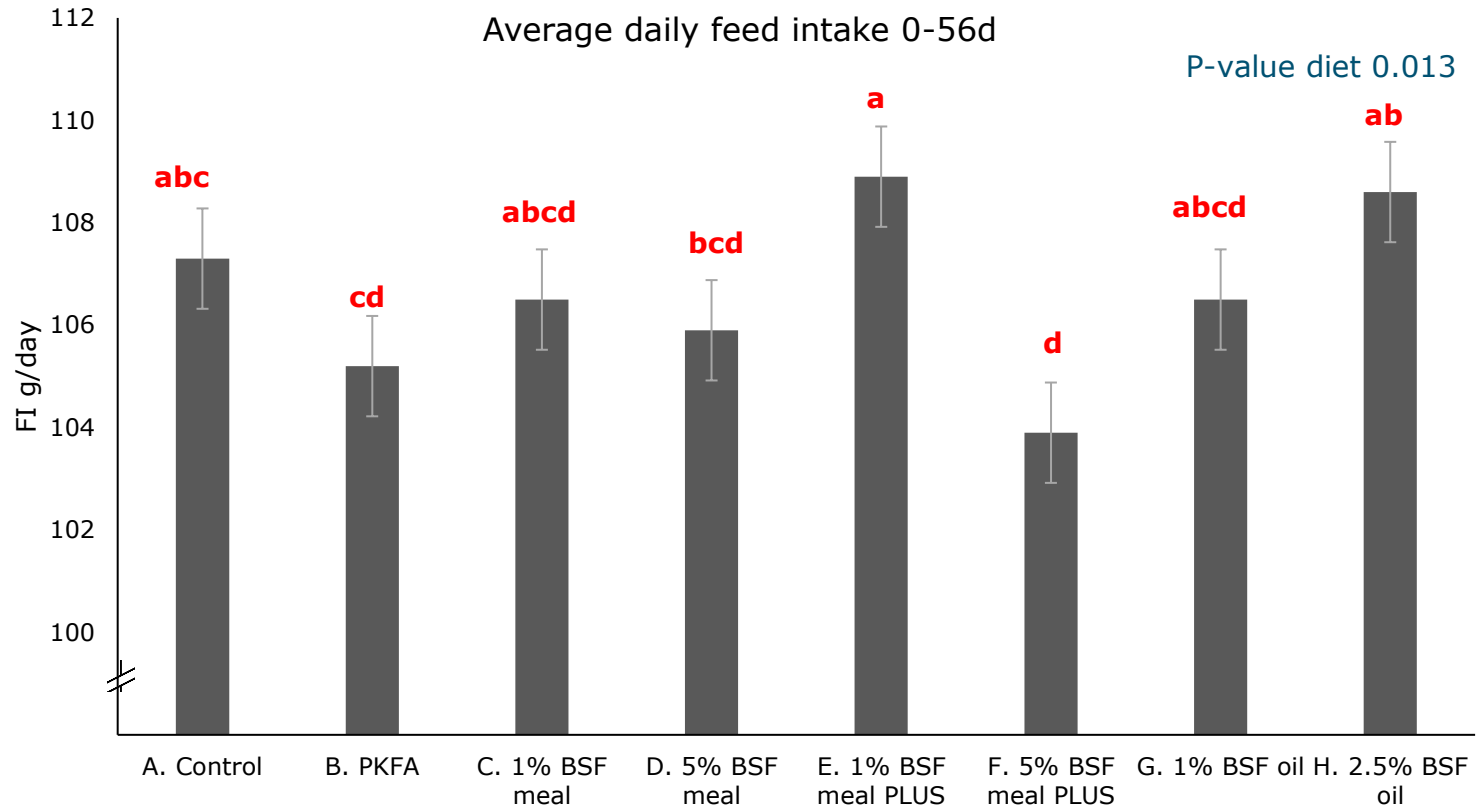
# Experimental Period



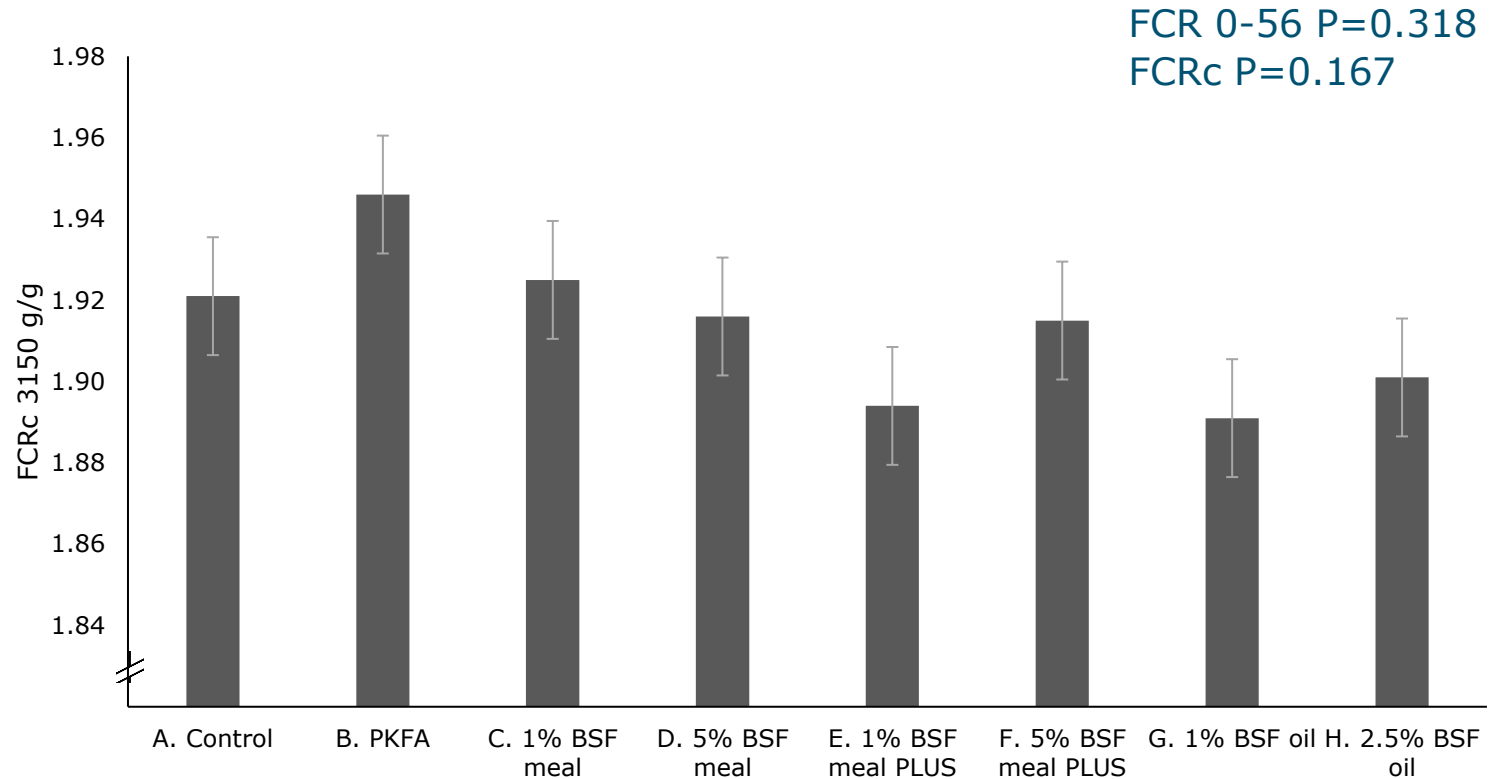
# Effects of diet on body weight



# Effects of diet on feed intake

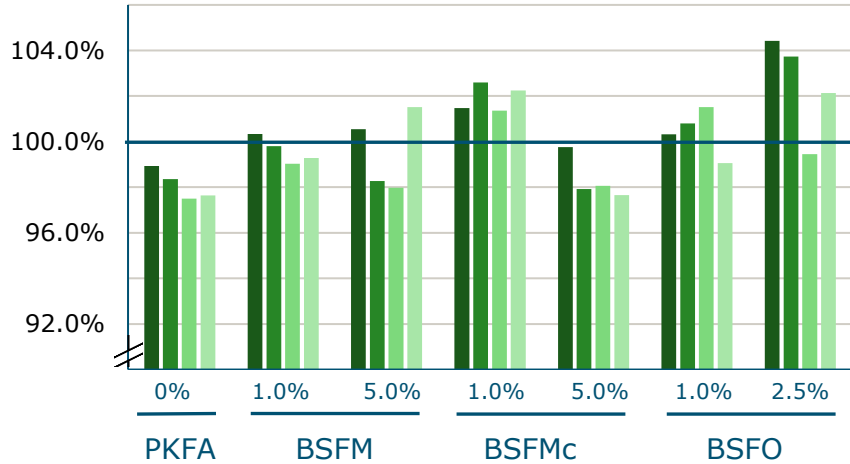


# Corrected FCR 3150g

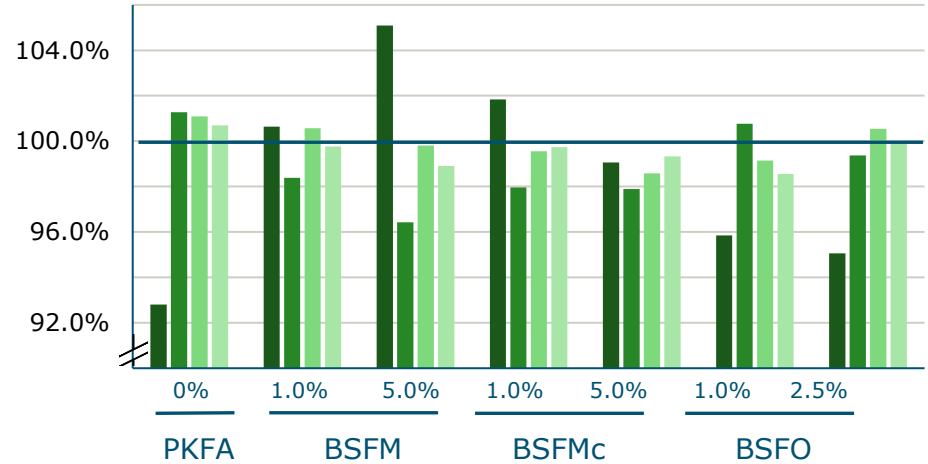


# In relation with the control treatment; FCR and BWG

## Relative BWG



## Relative FCR

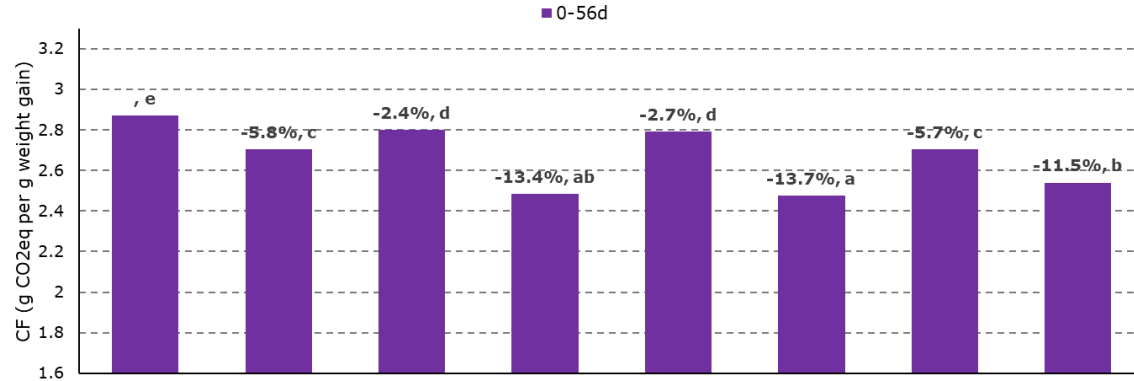


■ Starter ■ GrowerI ■ growerII ■ Finisher

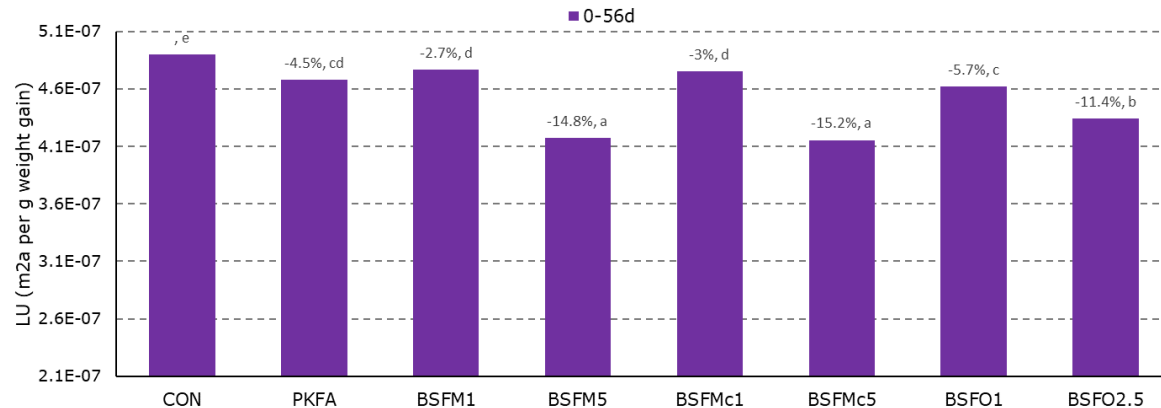
# Carbon footprint (g CO<sub>2</sub> eq)

Replacing SBM and SBO from Brazil with BSF products reduced the environmental impact of the feed and chicken meat being produced in a 1-star Better Life production system!

CF (g CO<sub>2</sub>eq per g body weight gain)



Land use (m<sup>2</sup>a per g weight gain)



# Conclusions

Partial replacement of soybean meal or oil with BSF meal or BSF fat:

- Reduces the environmental impact
- Limited impacts on growth performance parameters
- Effects on growth depend on the inclusion level of products and the age of broilers
- No positive or negative effects on welfare
- Effects on health were observed

# Large scale study

- Treatment: standard (farm) diet program vs. farm diet program with 1% insect oil (LipidX)
- Data collected from 6 farms with 2 houses during 2 consecutive rounds (except 1 farm, only 1 round)
  - Performance (live weight, FCR, mortality)
  - Slaughter results (slaughter quality / yields)
  - Welfare measurements (FPD, HB, injuries, cleanliness, gait) - due to AI, only 2<sup>nd</sup> flock of each farm was measured
  - Litter quality (visual)

# Study design

- In each round on each farm, certain barns assigned to 'Insect oil', others to Control
  - Mostly cross-over: barn A is 'Insect oil' in round 1, it will be Control in round 2
- Pairwise comparisons (Wilcoxon signed rank test)
- Control vs. 'Insect oil' *within Farm and Round* is 1 paired observation

# Other read-outs

- Carcass quality by the standardised system for broilers at the slaughter line (IKB Kip, 2017):

Dead on arrival, total rejections, overall quality score and footpad lesion score

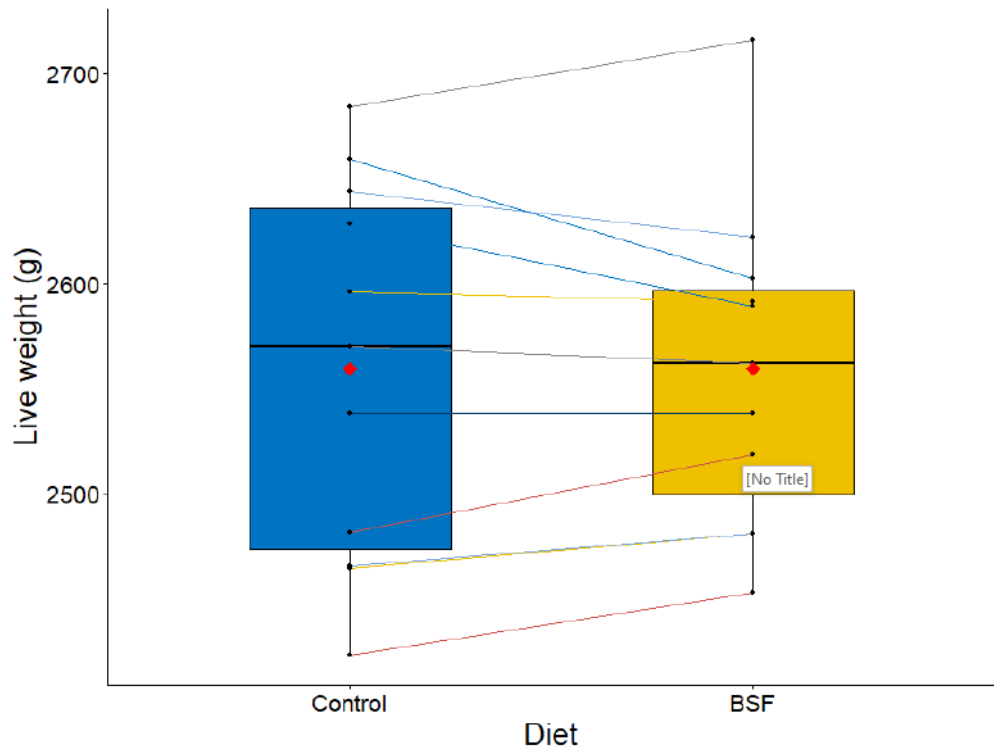
- Footpad score by the automatic system according to the Swedish 3-point scale for dermatitis.
- Welfare observation (before delivering birds):

150 broilers per barn at six locations for gait scoring

125-150 broilers in five locations for footpad lesions, hock burns, cleanliness, injuries

Litter quality scored visually

# Live weight (g)



Connecting lines coloured by Farm

1 line = 1 Round in 1 Farm

Treatment effect is reflected by the connecting lines (= the difference between Control and BSF oil within Round on a Farm)

- Mean difference: mean of these "slopes"
- Median difference: median of these "slopes" (more robust to "outliers")

Mean [median] difference: 0 g [0 g]

P = 1

# Performance results

	<b>Control</b>	<b>Insect oil</b>	<b>Sign</b>
n flocks	11	11	No
Live weight (g)	2559	2559	No
FCR (field)	2.024	2.031	No
Feed (g)	5164	5196	No
Mortality (%)	2.32	2.07	No
EPEF	220	221	No

[No Title]

# Carcass yields and slaughter quality

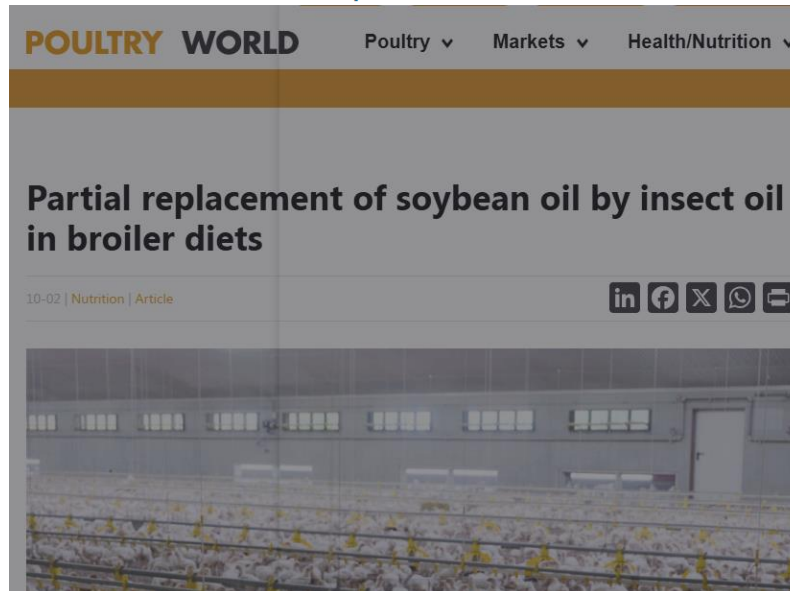
- Carcass yields, such as carcass, breast cap, wing, and saddle were comparable between the treatment groups
- Slaughter quality was comparable between treatment groups

# Welfare

- Diet effect was found on one farm only, and on this farm, scores for gait, footpad lesions, hock burns, and cleanliness were lower (better) on the test diet.
- There was a farm effect on litter quality, meaning that litter quality differed between farms independent of the diets used.

# Conclusion

*Replacement of 1% soy oil by 1% insect oil from the black soldier fly is possible without compromising the performance results, litter quality, welfare, slaughter yields and slaughter quality of Better Life 1-star broilers under practical conditions.*



# Pilot 2

## Aim:

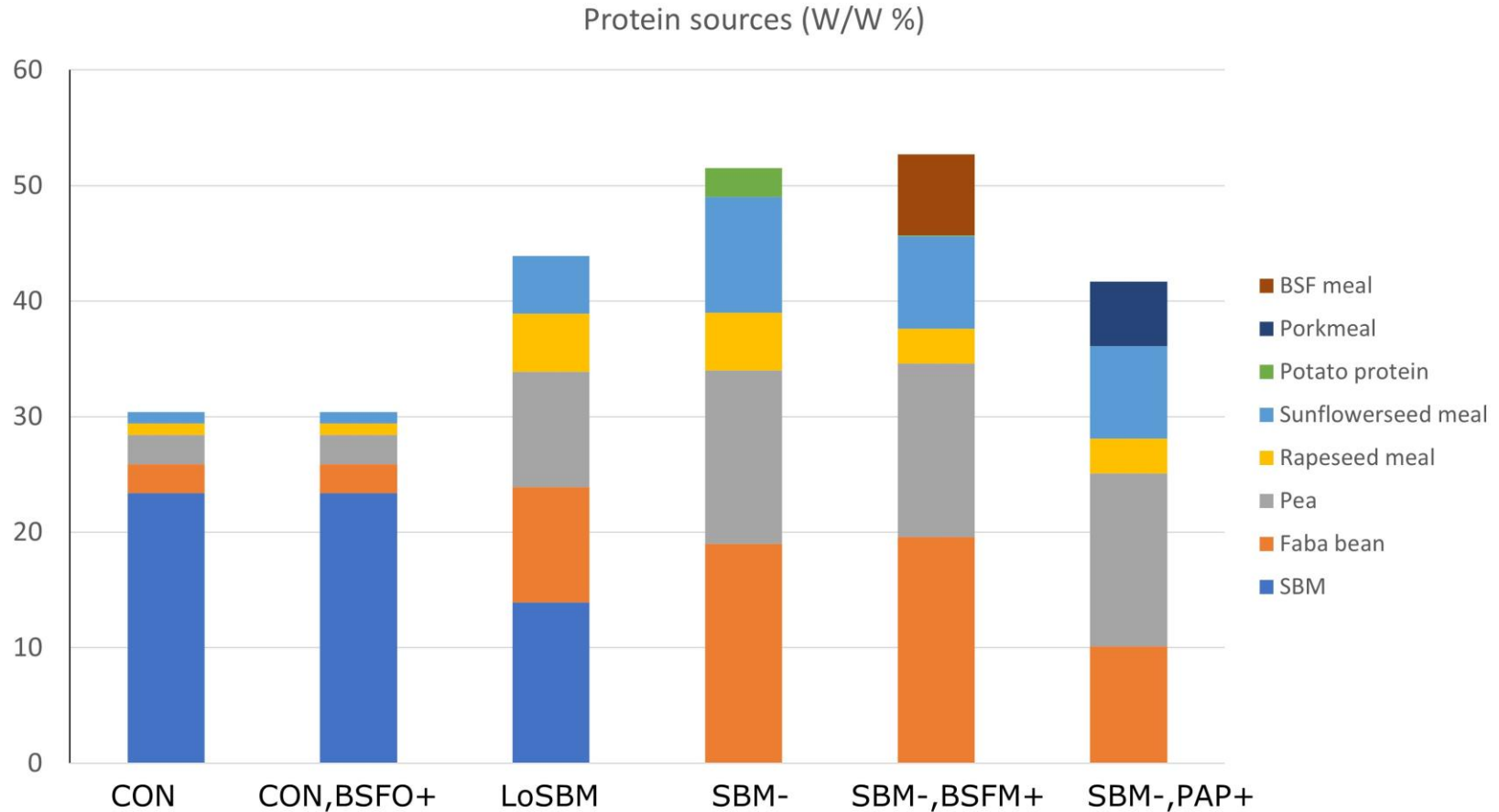
To study the effects of partial or complete exchange of soybean meal (SBM) by insect-based products (ProteinX, LipidX and PureeX) and regionally grown alternative protein (and oil) sources (e.g. peas, field beans, SFSM, RSM, PAPs) on performance, health, carcass characteristics, animal welfare and sustainability of Better Live 1-star broilers.

# Study Design

- Breed: Hubbard JA757
- Trial facility: WBVR, Lelystad
- Experimental period: 0-56 days
- 6 treatments X 8 replicates
- Experimental unit: Pen
- Number of broilers: 19/pen

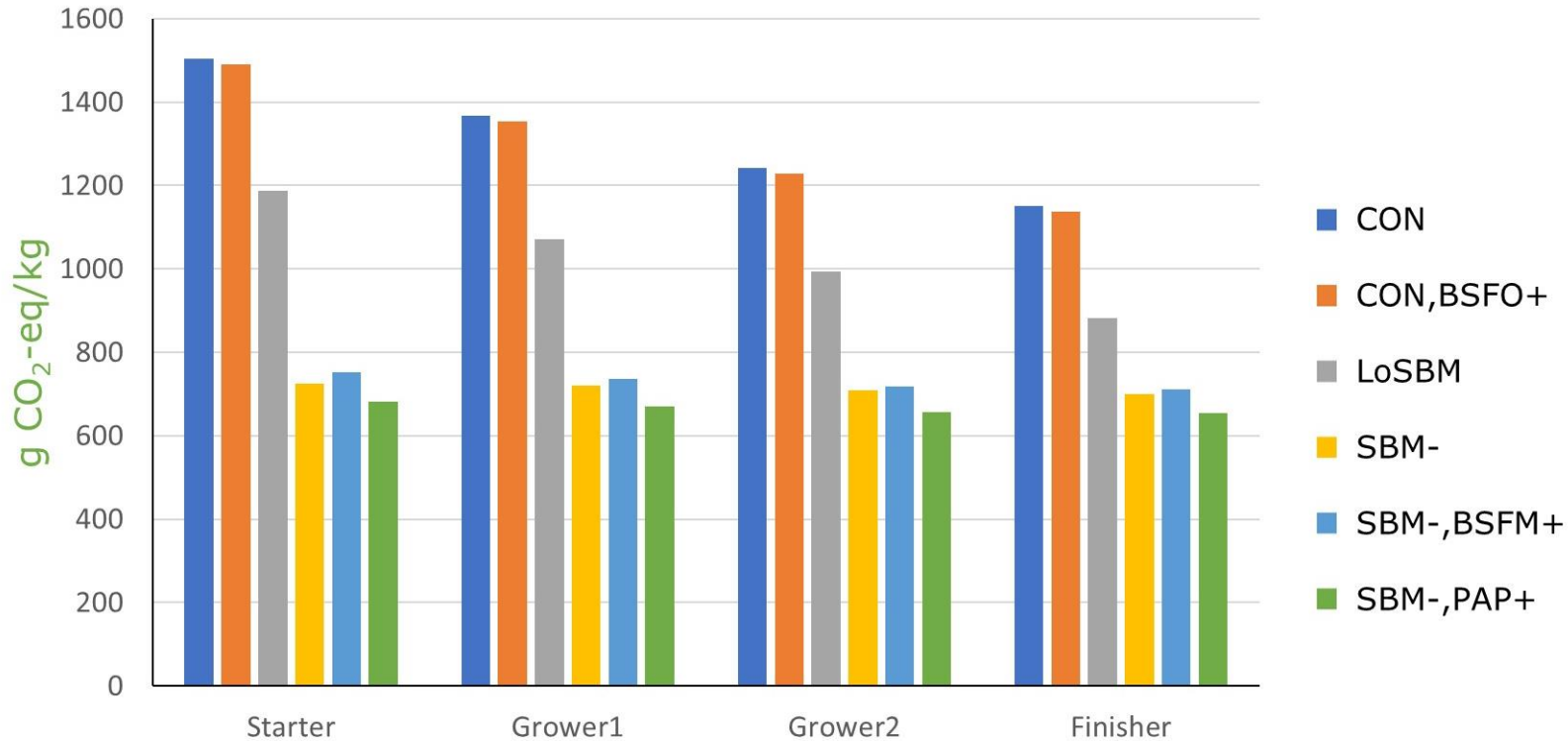
Treatment	Description
1.CON	Control
2.CON,BSFO+	Control + 1% LipidX
3.LoSBM	Reduced SBM + local plant protein + 1% LipidX
4.SBM-	No SBM + local plant protein + 1% LipidX
5.SBM-, BSFM+	No SBM + local plant protein + 6.6% ProteinX
6.SBM-,PAP+	No SBM + local plant protein + 1% LipidX + 5.6% PAPs
7. CON+BSF slurry	Control + 5% PureeX
8.Simulated #7	Control+ 0.8% ProteinX + 0.6% LipidX + 3.6% Water

# Challenges in feed production

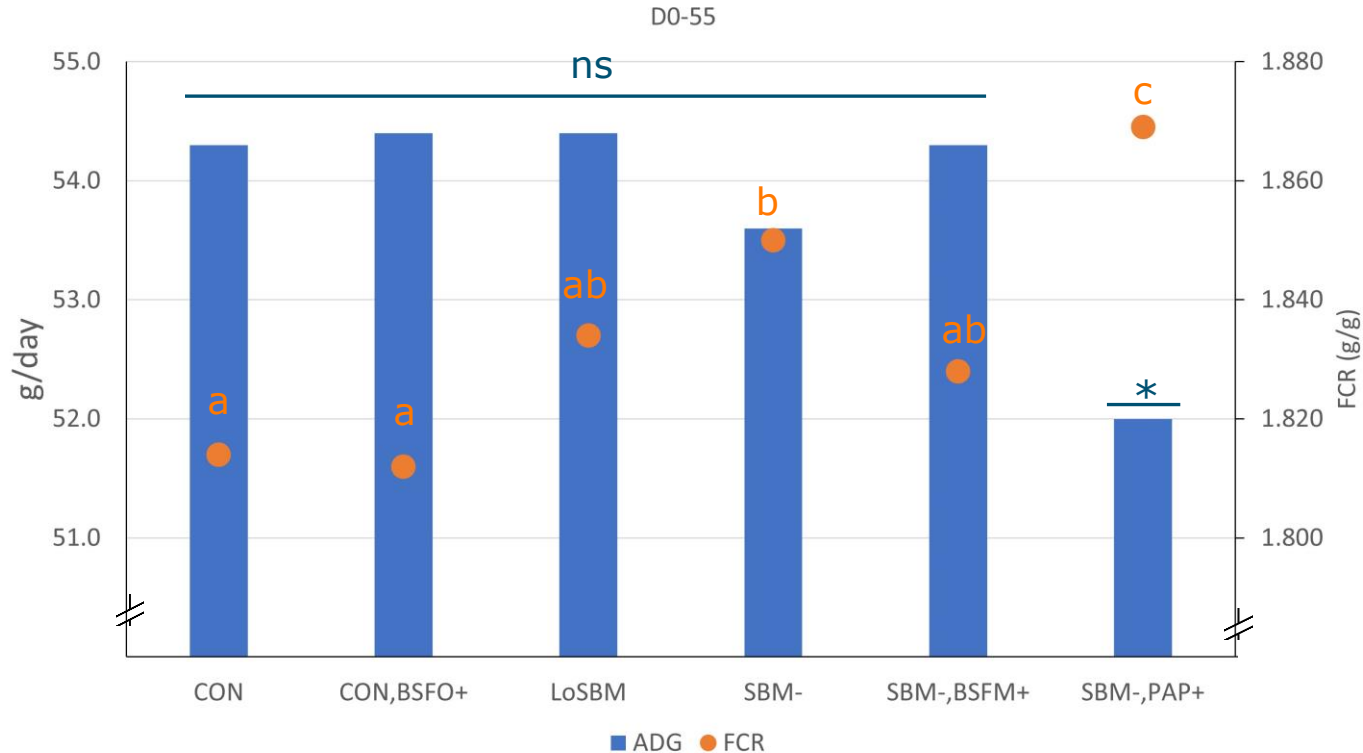


# Environmental impact of diets

Carbon Footprint including Land Use Change



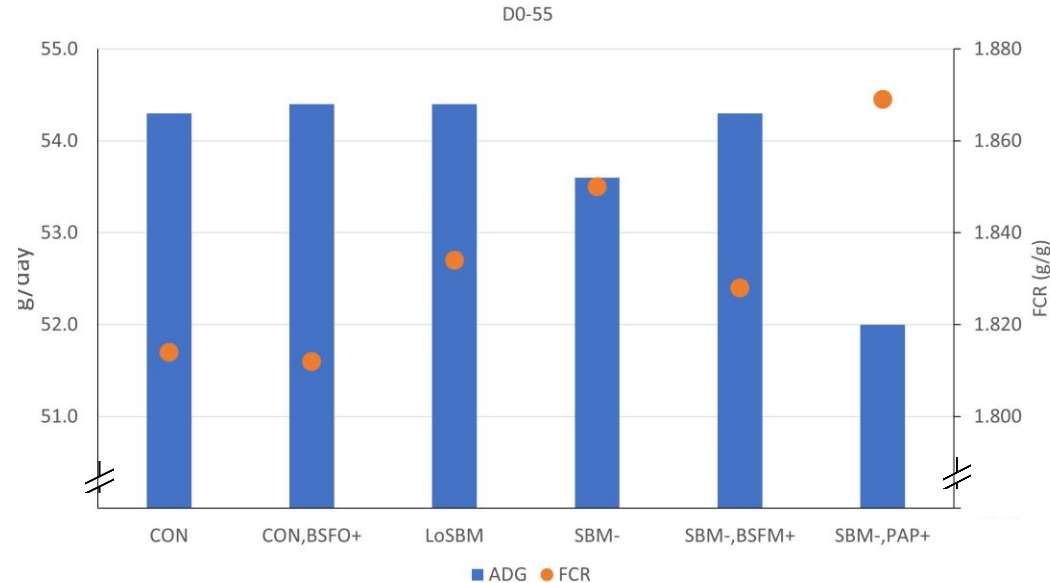
# Effects on growth performance



- Broilers maintained growth performance when BSFM was included in SBM-free diet

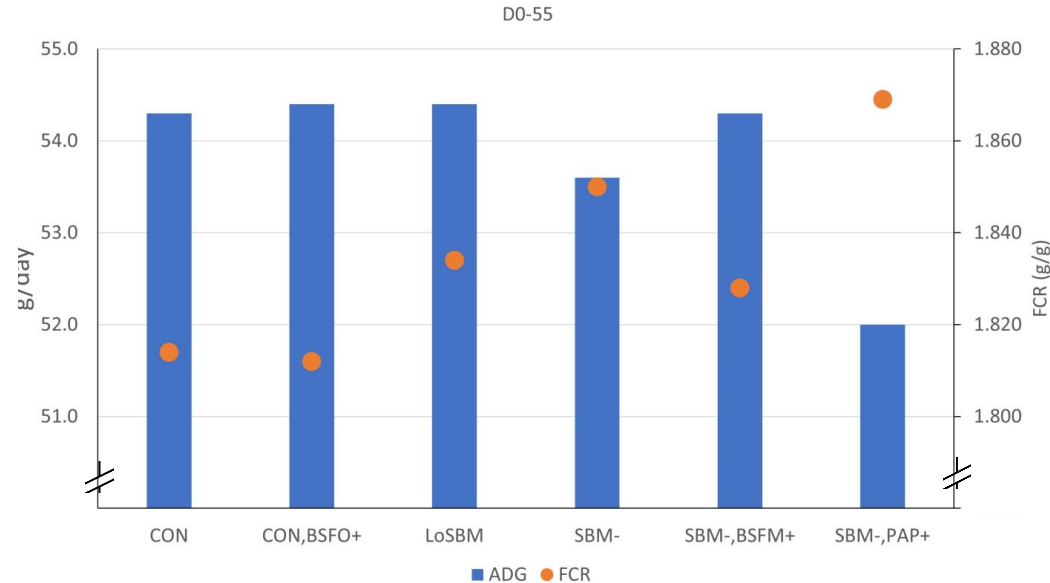
# Effects on growth performance

- LoSBM:  
Higher FCR  
Lower environmental impact
- SBM-free:  
Slightly compromised BW  
Low environmental impact
- SBM-free + Insect meal  
Maintained growth and efficiency  
Higher price



# Effects on growth performance

- LoSBM:  
Higher FCR  
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- SBM-free:  
Slightly compromised  
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- SBM-free + Insect meal  
Maintained growth and efficiency  
Higher price
- **Is FCR still a practical indicator of success?**



# Conclusion

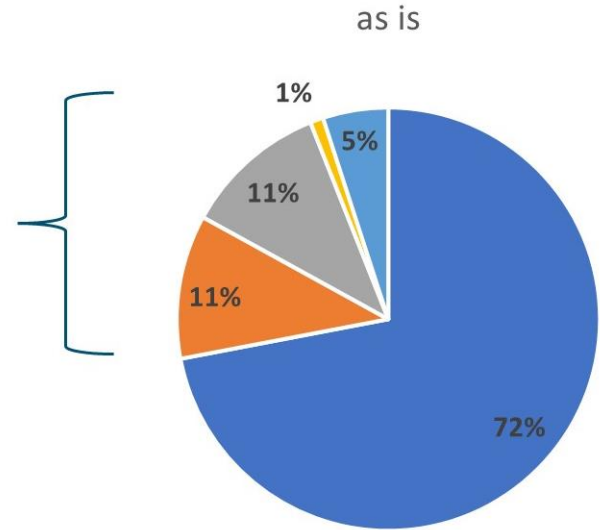
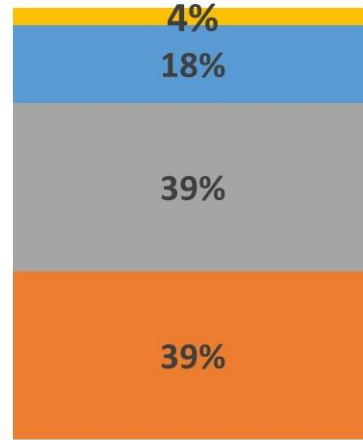
- Slow-growing broilers maintain growth efficiency when soybean meal is completely replaced with local protein sources.

Further investigation:

- Indicators to predict the nutritional value of by-products
- Efficiency indicators instead of FCR

# PureeX©

- Minced Black soldier fly larvae
- Frozen paste with high viscosity with 72% moisture



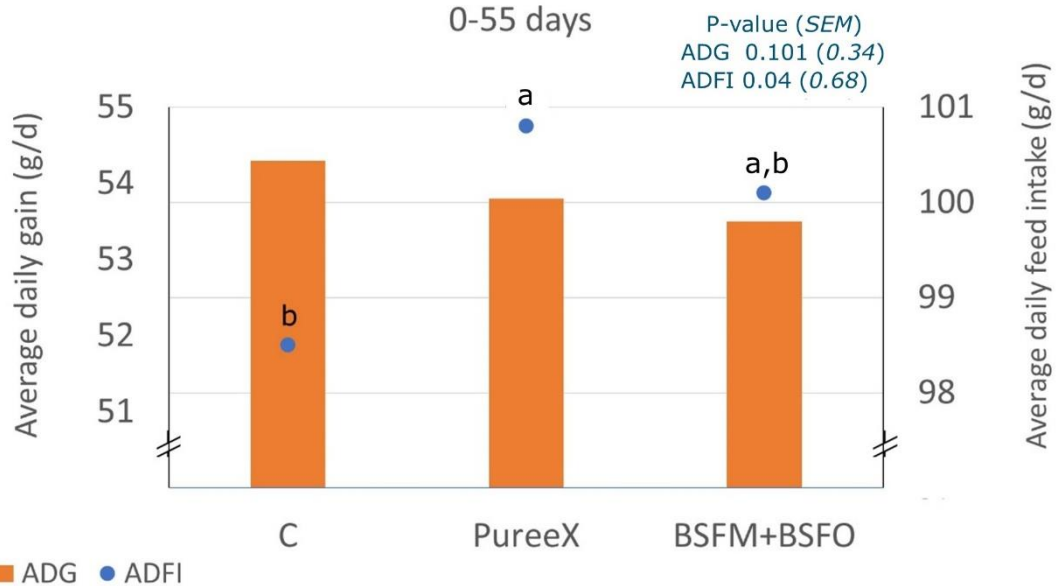
■ Moisture ■ Protein ■ Fat ■ Ash ■ Other

# Study Design

<b>Treatment</b>	<b>Description</b>
<b>A</b>	Control
<b>B</b>	5% PureeX©
<b>C</b>	0.8% BSFM and 0.6% BSFO and 3.5% water

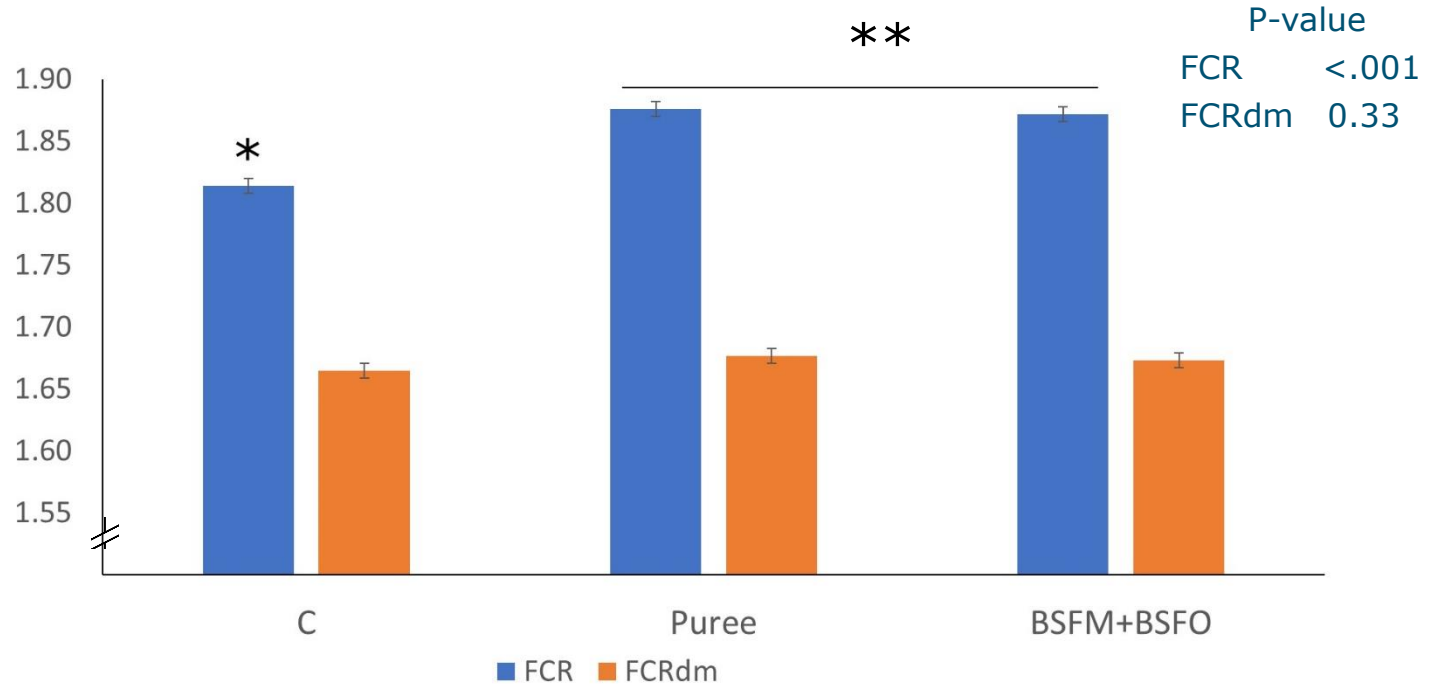
- SBM substitution: starter and grower I (6%), grower II (8%), Finisher (11%)

# Day 0-55



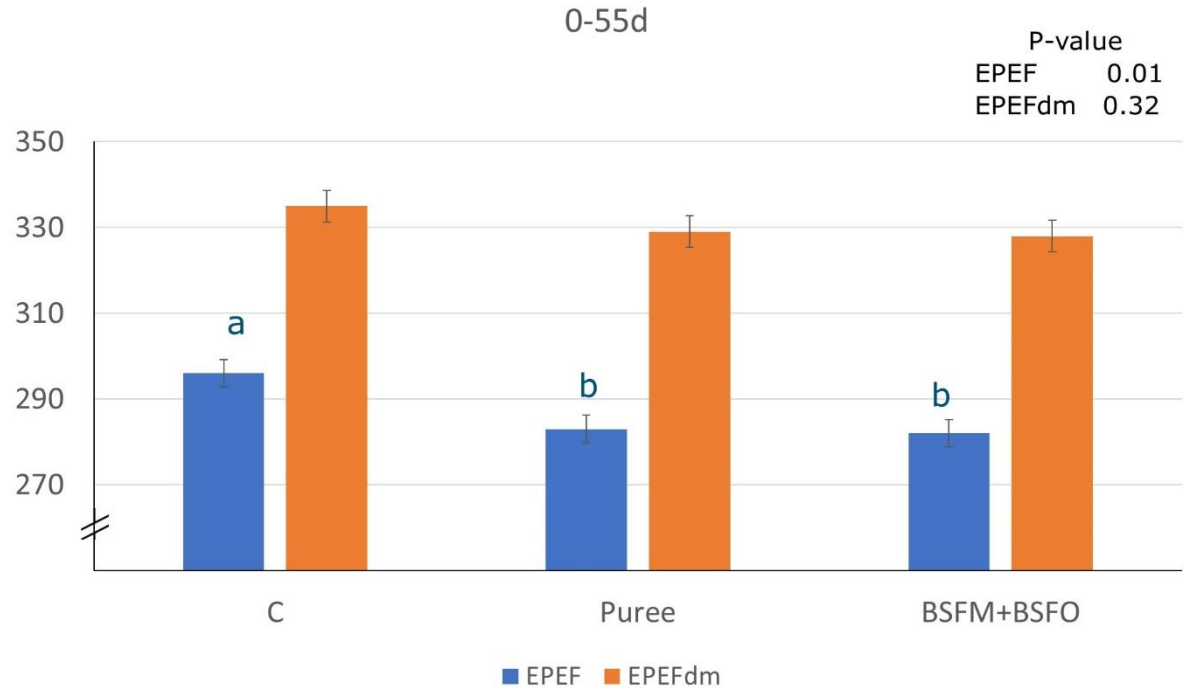
- Rise in feed intake
- Decline in body weight gain was not significant
- Lower EPEF (296 vs 283)
- Lower CFP/kg BW (2247 vs 2195 and 2178 g CO<sub>2</sub>-eq/kg)

# FCR vs FCRdm 0-55days



- Effects of diet on dry matter feed intake was not significant.
- No difference in FCR based on dry matter feed intake!

# Results



- The effects of diet on EPEF based on dry matter feed intake was not significant.
- No meaningful effects on welfare

# Conclusion

- Potential for including less-processed insect products and reducing SBM in pelleted broiler feed without negative effects on growth performance.

Further investigations:

- Technical challenges for feed factories; Are we ready?
- Further study the effects on digestive tract development and functionality
- A growth efficiency indicator considering the environmental impact of the feed

# PPP conclusion

- Slow-growing broilers maintain growth rate when SBM is replaced by local protein sources
- Reduces the environmental impact of feed/meat

# Acknowledgement

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  - VENIK (Verenigde Nederlandse Insectenkwekers)
  - Protix B.V.
  - ForFarmers Nederland B.V.
  - ESBRO B.V.