



Instituto Nacional de
Investigação Agrária e
Veterinária, I.P.



ENTOVALOR

Effects of replacing soybean with Black Soldier Fly (*Hermetia illucens*) larvae in broiler feeding programs

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ENTOVALOR - Insects as an opportunity in by-products valorisation

Objectives:



- ✓ Reuse food by-products
- ✓ Reintroduce the nutrients present in organic by-products in the value chain
- ✓ Contribute to the establishment of quality standards and biosafety
- ✓ Perform a proof of concept for industrial and commercial application
- ✓ Develop new products

Coordination: Ingredient Odyssey/Entogreen

- 1 Research Entity (INIAV)
- 4 Agro/Feed Enterprises (ENTOGREEN, AGROMAIS, Rações Zêzere, CONSULAI)

- Chemical evaluation of substrates and larvae
- In vitro digestibility of larvae
- *In vivo studies with broiler*
- Egg sensory analysis
- Agronomic valorization



Objectives

- To evaluate the effect of the partial replacement of soybean meal and soybean oil by insect meal (BSF larvae), in broiler diets, on the digestibility and productive performance.



Experimental diets

4 dietary treatments:

Control (**BSF0**) and partial replacement of soybean meal and soybean oil by BSF larvae meal (**BSF25, BSF50, BSF75**)

Isoenergetic, Isoproteic

Digestibility Trial

48 Broilers ROSS 308 (0-28 days old)

Randomly distributed by experimental diets

Individually allocated in metabolic cages

- Daily control of feed and water intake
- Daily excreta sampling
- Week weight record

Chemical Characterization: Proximal analyses (feed and excreta)

Calculations: FCR, Apparent Digestibility (DM, N , GE, NDF)

Statistical analysis: Repeated measurement analysis using the proc mixed of SAS

Ingredient composition of experimental diets (%)

Ingredient	BSF0 <i>Control</i>	BSF25	BSF50	BSF75
Corn	46,8	48,9	51,1	45,5
Wheat	10,0	10,0	10,0	10,0
Soybean meal	35,3	27,3	19,3	8,5
Soybean oil	4,1	2,2	0,2	--
BSF larvae meal	0	7,8	15,6	23,4
Sunflower meal	--	--	--	4,0
Wheat bran	--	--	--	4,5
Minerals & Vitamins	3,1%	3,1%	3,0%	3,0
AA Meth Lys Tre	0,7%	0,8%	0,9%	1,1

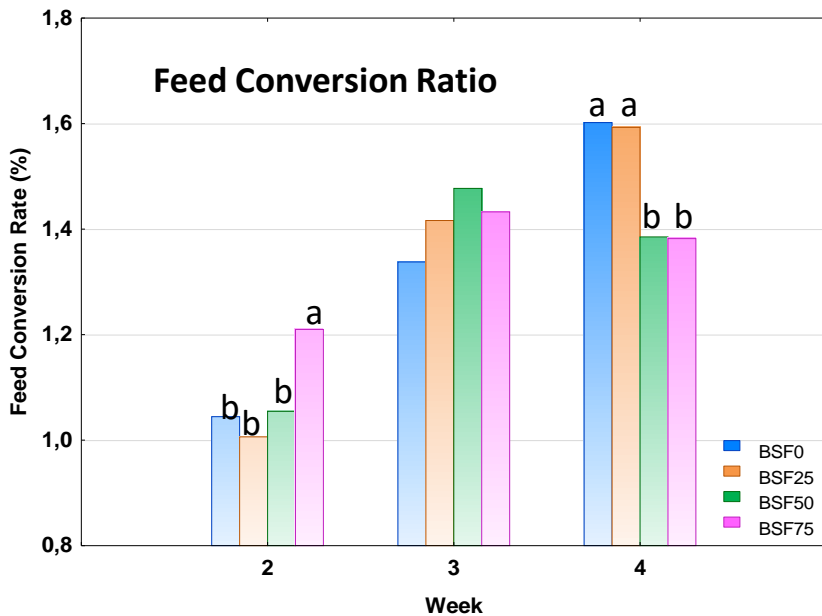
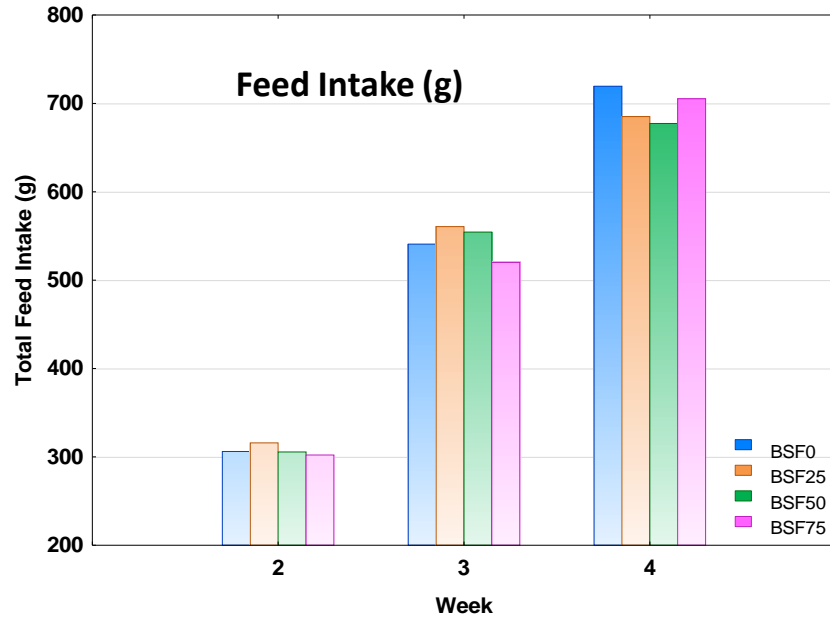
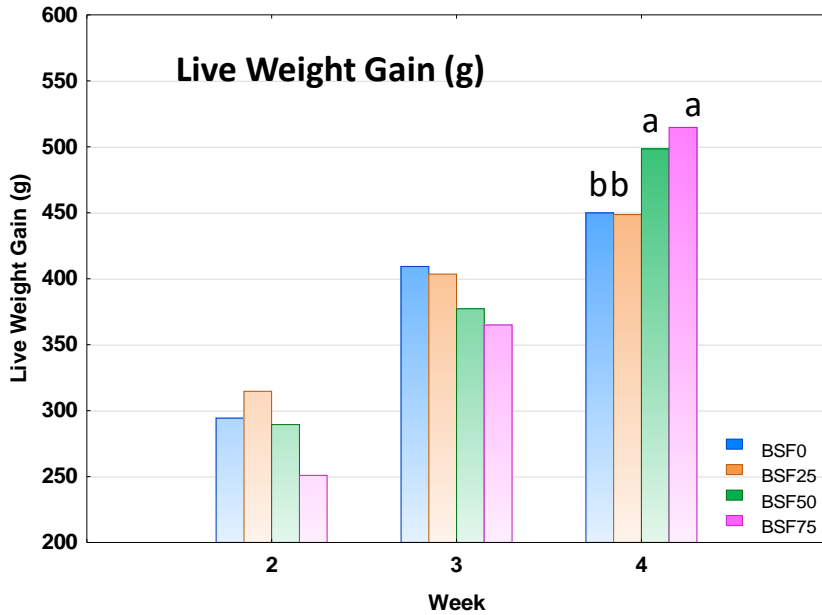
Chemical composition of experimental diets (g/kg DM)

Parameter	BSF0	BSF25	BSF50	BSF75
Dry matter (g/kg)	878	880	875	881
Crude protein	235	242	234	228
Ether extract	68	66	68	69
NDF	116	121	129	164
ADF	48	49	55	67
Ash	60	66	68	77
Calcium	8.4	12.7	12.5	14.8
Phosphorus	6.7	7.7	7.6	8.5
Sodium	1.6	1.2	1.3	1.4
Potassium	6.6	6.5	6.0	5.3
Magnesium	1.7	1.4	1.5	1.6
Gross energy, Mj/kg DM	16.8	16.9	16.6	17.6

Results: Productive performance

	Diet	Diet * Week
Live Weight Gain (g/day)	NS	***
Average Daily Gain (g/day)	NS	**
Total Feed Intake (g)	NS	NS
Daily Feed intake (g/day)	NS	NS
Feed conversion rate (%)	NS	***

Results: Productive Performance



Overall experimental period

➤ No differences between dietary treatments

LWG: 380 g

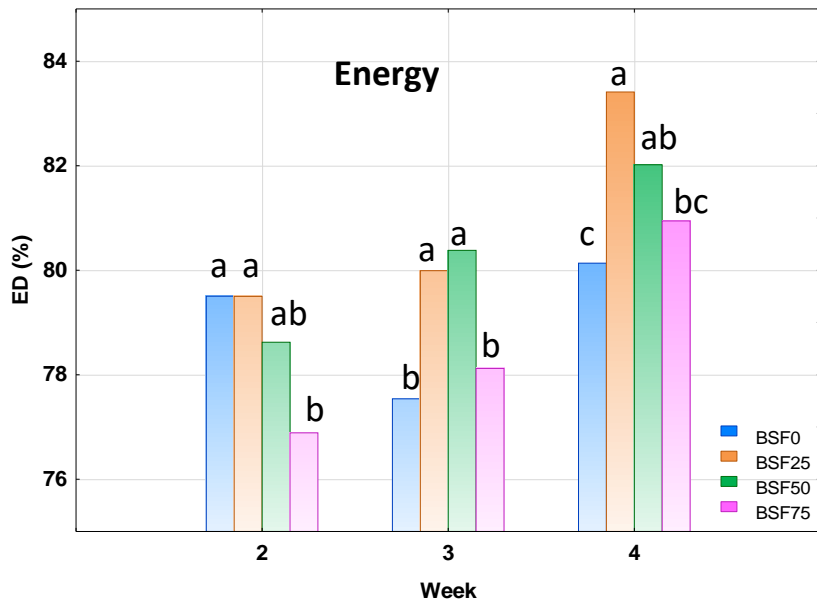
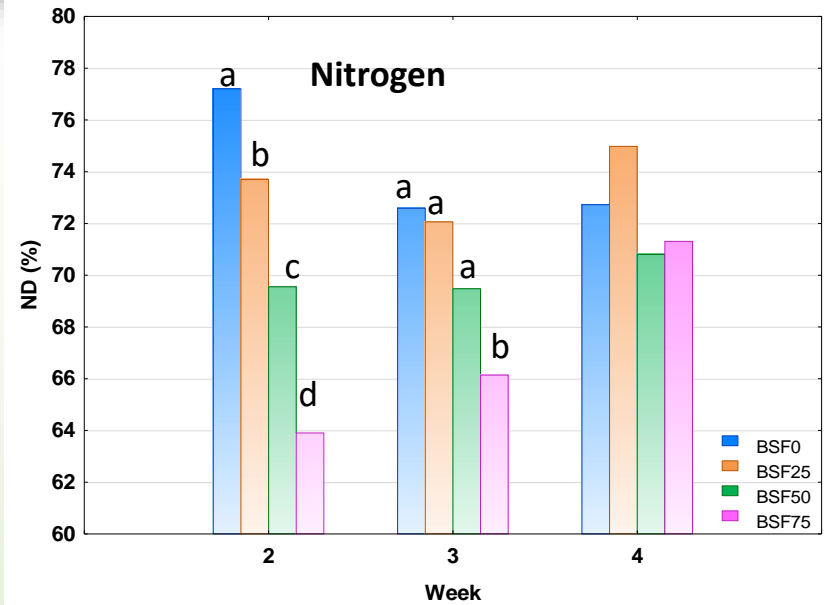
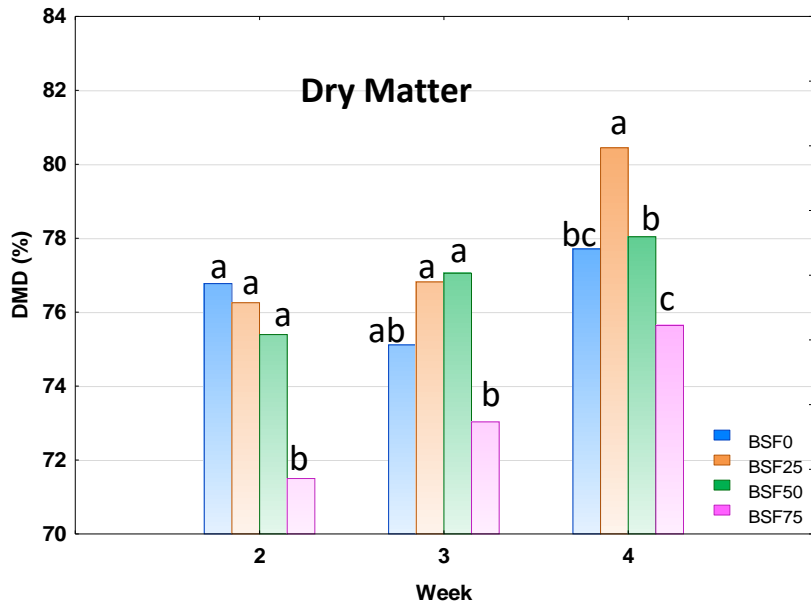
Feed intake: 515 g

FCR: 1.35

Results: Apparent Digestibility

	Diet	Diet * Week
Dry matter excreted (g/day)	***	**
Dry matter digestibility (%)	***	*
Nitrogen digestibility (%)	***	***
Energy digestibility (%)	***	*
NDF digestibility (%)	NS	NS

Results: Apparent Digestibility (%)



Overall Experimental period

BSF50 and BSF75: lower digestibility

BSF25: 79% DMD; 74% ND; 81% ED

Conclusions

- Diets with larvae meal have higher content of NDF, ADF, Ca, P
- Productive performance was not affected by dietary treatments
- The inclusion of BSF larvae meal in poultry diets to partially replace soya at 25 %, as alternative protein source, may be a sustainable solution in broiler diets.
- The level of replacement of 75 % compromises the apparent digestibility of nutrients.

Effects of replacing soybean with Black soldier fly (*Hermetia illucens*) in broiler meat quality

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Poster S37: 13

Objectives

- Evaluate the impact on meat quality of replacing soy (soybean meal and soybean oil) with BSF larvae meal in iso-energetic and isoprotein broiler feeding programs

Background

- The worldwide increase in broiler production has a considerable environmental and economic impact, increasing the urgency to find sustainable alternative feed ingredients
- Recent studies indicate that some species of insects have great production potential and may be a source of both proteins and lipids, which is the case of Black Soldier Fly (BSF) (*Hermetia illucens*)
- However, it is necessary to evaluate possible factors that might alter meat quality parameters, since these are critical factors for the market success of the final product



Methodology

- 24 Ross 308 broiler (1 day old), 6 in each experimental diet
- Four different treatments of a basal diet where soybean (meal and oil) were replaced by BSF (BSF0) control, 25% (BSF25), 50% (BSF50) and 75% (BSF75) of dry BSF larvae
- Animals were slaughtered at 28 days of age
- Meat quality parameters were evaluated in breast muscle - proximal composition

Acknowledgment: This work has received financial support from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017720.

Conclusions

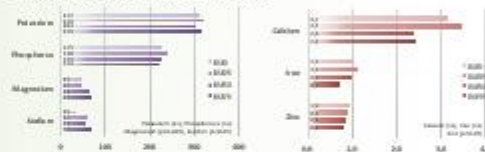
- The replacement of soybean meal and oil with BSF larvae meal had no significant influence on most relevant parameters of meat quality and nutritional composition of broiler breast meat



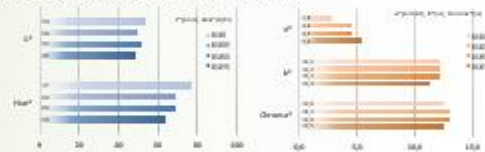
15-means for proximal composition of broiler breast muscle

Proximal Composition (dry matter)	Experimental diets				P-value
	BSF0	BSF25	BSF50	BSF75	
Moisture	74.28	74.45	74.31	74.26	ns
Protein	23.84	23.12	22.15	22.62	ns
Fat	1.00	1.26	1.37	1.28	ns
Ash	1.13	1.17	1.12	1.26	ns

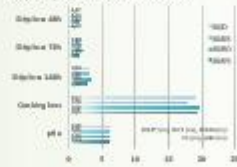
Mineral content of broiler breast muscle (mg/100 g)



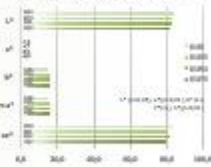
Colour parameters of broiler breast muscle 24h post (CIE Lab)



Physical properties of broiler breast



Colour parameters of cooked breast meat



Diet composition with soybean meal and soybean oil replaced by dry BSF larvae

Ingredient	BSF0	BSF25	BSF50	BSF75
Casein	20.0%	20.0%	21.1%	20.0%
Soybean meal	12.0%	10.0%	10.0%	10.0%
Soybean oil	3.0%	3.0%	3.0%	3.0%
Wet feather meal	4.0%	4.0%	4.0%	4.0%
Cellulose	—	—	—	—
Choline	—	—	—	—
Minerals & vitamins	0.2%	0.2%	0.2%	0.2%
Antioxidants	0.2%	0.2%	0.2%	0.2%

Chemical composition of experimental diets

Parameter (g/g DM)	BSF0	BSF25	BSF50	BSF75
Dry matter	85.1	85.0	84.5	85.1
Crude protein	23.9	23.0	22.1	22.6
Crude fat	1.0	1.3	1.4	1.3
Crude ash	1.1	1.2	1.1	1.3
Crude fibre	0.0	0.0	0.0	0.0
Crude starch	0.0	0.0	0.0	0.0
Crude lignin	0.0	0.0	0.0	0.0
Crude cellulose	0.0	0.0	0.0	0.0
Crude hemicellulose	0.0	0.0	0.0	0.0
Crude pectin	0.0	0.0	0.0	0.0
Crude lignin	0.0	0.0	0.0	0.0
Crude cellulose	0.0	0.0	0.0	0.0
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Crude cellulose	0.0	0.0	0.0	0.0



THANK YOU FOR YOUR ATTENTION

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